SCOTTISH JOURNAL OF
ARTS, SOCIAL SCIENCES
AND
SCIENTIFIC STUDIES

VOLUME 5, ISSUE I
OCTOBER, 2012

Articles

The History and Shaping of Caribbean Literature

Julia Udofia, Ph.D

Dept. of English, University of Uyo, Uyo, Nigeria

+2348033476317

dr_udofia@yahoo.com

Abstract

The abrupt "beginning" of the history of the Caribbean, coupled with the brutal mode of occupation and violence among the colonizing forces has led many scholars to conclude that the Caribbean is "historyless" and unlikely to proceed further than its crude and violent beginnings. In addition is the problem of the racial and cultural diversity of the area, occasioned by the influx of large numbers of people of diverse background.This paper examines this peculiar history of the Caribbean, as well as its attendant effect on the criticism of the literature of that area. It also highlights the various responses (literary) and views of the individual Caribbean writers on these historical realities, since Caribbean literature is also to some extent, a reaction to the history of the place.

Introduction

The history of the founding and settling of the Caribbean has implications for the societies that have emerged. Following the accidental "discovery" of the place in 1492 by Christopher Columbus, the Caribbean environment has been a fertile ground for writers whose recreations and explorations of their locale as ways of examining the relations between the land, the people, the psychological dimensions of their situations prefigure their determined struggle to survive, and bond together as ways of defining their humanity and dignity. This paper examines this peculiar history of the Caribbean as well as its attendant effect on the criticism of the literature of that area. It also highlights the various literary responses of the individual writers of this region to these historical realities.

The History of the Caribbean

The history of the Caribbean is peculiar. It does not evolve gradually and naturally out of a remote mythological and archaeological past, but begins abruptly with the "discovery" of the Bahamas in 1492 by Christopher Columbus. This abrupt beginning has led historians like Eric Williams (1970) and literary artists like V.S. Naipaul (1969) to assert that the Caribbean is merely a geographical expression which lacks a noteworthy history. Naipaul, in particular, claims that the West Indies is a sterile, static, manufactured society due to the accidental nature of its discovery and the brutal mode of occupation and violence among the colonizing forces. Many Caribbean scholars have also concluded that the area is "historyless" and unlikely to proceed further than its crude and violent beginnings. According to Naipaul, "history is built on creation and achievement and nothing was created in the West Indies", (1969, 39).

This lack of creation refers to the dearth of monuments, libraries and other visible public amenities other than the remains of old plantation houses and memoirs of the slave experience. The European colonizers regarded the area as one whose economic potentials were to be fully exploited, but not a place to settle in permanently. This was why the plantation system was entrenched and thence, the proliferation of absentee landlords who enjoyed the fruits of their labour outside the West Indies. And so, the problem with West Indian history does not lie solely in its mode of discovery as there was also the problem of jealousy and in-fighting among the colonizers who were single-minded in their quest for quick self-profit.

Initially, Columbus thought that the West Indies would open up a lucrative trade route for Spain. Also, because of the proliferation of gold body ornaments on the Bahamans he had met, Columbus concluded that there was an inexhaustible supply of gold to be obtained from the West Indies. Thus, his primary interest was the economic exploitation, and not the improvement of the area. Later on, it was discovered that the gold supply was finite and the colonizer's attention turned to the large-scale cultivation of sugar which was then a highly lucrative crop.

At all times, the European presence in the Caribbean was primarily motivated by selfish economic considerations. Because of this, they did not hesitate to undercut one another and eventually seek all inhumane means of obtaining a steady supply of easily replaceable labour for the effective cultivation of their plantations.

The West Indies can be referred to as an artificially created society because with the exception of the indigenous Indian population which was largely swiftly exterminated, the inhabitants of the Caribbean either migrated or were forcibly transported there. With this conglomeration of people of different races and religious beliefs and with different motives of being in the Caribbean, it was difficult to create a common Caribbean ethos, especially, given the fundamental inequalities created by the institution of slavery.

During Columbus's second trip to the Caribbean in 1493, he brought Spanish domestic cereals, vegetables, fruits and sugar cane to the West Indies. It is therefore, correct to regard the West Indians as an imported people in a largely imported environment. The early and later imperialists in the Caribbean had the

sole motive of exploiting the natural, mineral and agricultural resources of the area both for personal benefits and for the good of their various mother countries.

The lure of gold, sugar and slaves thus precipitated imperialist forays into the area by Spain, Portugal, Britain, France and the Netherlands. Each of these imperialists fought to obtain a considerable share of the Caribbean wealth. And this gave rise naturally to piracy, double-crossing, brutality and lack of cohesion among the powers. Each group of Europeans had its own language, religion and political allegiances. They were also constantly engaged in the bid to protect or expand their territories and so had little opportunity or need to exert a unified political and cultural control over the non-European population.

Furthermore, the Europeans' inability to impose a common creolised cultural ethos on the slaves who were also multi-cultural in origin was exacerbated by the imperialists' lack of interest in the continuous spiritual and physical welfare of the Islands and its inhabitants. As a result, the negro slaves were largely left to evolve their own cultural expressions and value systems based on vestiges of different African traditions, various European influences and communal responses to the new milieu.

Slavery in the Caribbean

The Spaniards who were the original imperialists in the Caribbean already had a system of slavery which made it easy for them to resort to this method of procuring labour for their mines and plantations. Several sources of labour, including aboriginal Indians, white slaves and convicts labour were sought before blacks were brought into the West Indies. Negro slavery was initiated by the king of Spain on September 3, 1501 and began with the transportation of numbers of Christian negro slaves from Spain to the West Indies. African slave trade began shortly afterwards.

The mining of gold and to a greater extent, the discovery of the great economic potential of sugar-cultivation in the world market precipitated the institutionalization of slavery in the West Indies. Plantation slavery began in the 16th century and from that time onwards, the fortunes of the Islands were greatly influenced by the price of sugar. Also, the requirements of the sugar industry determined the nature of the West Indian population.

The cultivation of cane was highly capital-and-labour-intensive. The more sophisticated and efficient machines for extracting sugar were expensive and the crop itself was highly perishable which meant that it had to be processed shortly after harvesting. Also, the planting and harvesting of cane required considerable labour and the manufacturing process was arduous. The production of sugar on an economic scale therefore, required a considerable initial financial outlay and a large cheap labour force. Negro slavery provided easily available and replaceable unskilled labour. It also led to a change in the racial composition and social structure of the Islands.

Under slavery, the humanity of the blacks was progressively eroded, especially with the arduous work hours, stringent penalties for absenteeism and the promulgation of slave codes which gave legal sanction to slavery. These codes deprived the slaves of the freedom of movement and the simplest exercise of their freewill. For instance, they could not marry without their masters' permission, they could not own property, they were considered to be moveable property and could be punished even unto death by their masters.

This brutally indifferent method of slavery, coupled with the racial and cultural diversity found in the West Indies and the uprootment and dispossession experienced by the African slaves helped to rob the negroes of a sense of historical continuity and emphasized the lack of control over their lives. It also gave rise to such psychological traumas as alienation, rootlessness, inferiority complex and the creation of the colonial mentality. The cultivation of cane was thus, the basic reason for the institution of slavery and had important influences on the Caribbean psyche, such as the engendering of the isolationist outlook and an

endemic and crippling sense of provincialism, all of which are difficult to eradicate from the 21st century Caribbean mentality.

Abolition

There were three basic reasons for the abolition of slavery: economic, political and humanitarian. By the 19th century, the cultivation of sugar in the British and French West Indian colonies was no longer economically viable because cheaper sugar was obtainable from India and Brazil. Sugar producers in the colonies discovered that they produced sugar at a greater cost than its selling price, thus making it difficult for the plantation owners to make profit after caring for the needs of the slaves.

Politically, the abolitionist move was part of the increasing global moves by the industrial bourgeoisie against the landed aristocracy, such as the French revolution of 1789 and the victory of the North over the South in the American civil war.

On humanitarian grounds, slavery was considered the height of man's inhumanity to man and so, such figures as William Wilberforce sought the legal end to the institution of slavery. Abolition Acts were passed in Denmark in 1803, Great Britain in 1807, France in 1817 and Holland in 1818, while slavery was legally abolished in the British colonies in 1833, French colonies in 1848, and Dutch colonies in 1863.

The Post-Emancipation Caribbean

The post-emancipation period did not usher in immediate fundamental changes in the lives of the slaves. Financially, they were ill-equipped for freedom, yet many preferred to survive through subsistence farming or seasonal itinerant labour rather than work long hours for meagre wages in the plantations of their erstwhile masters. This created a vacuum in the labour force which was later filled by the migration of indentured Indian labourers to the West Indies. This wave of migration started in 1838 and ended in 1924 within which period approximately half a million Indians migrated to the Caribbean. This introduced new racial, linguistic and cultural complications into the already diversified West Indian society. The Caribbean thus, became a deterministic society where social status was predicated on skin pigmentation and people were divided into exclusive water-tight colour compartments. This situation intensified the psychosis nurtured by a sense of racial and cultural void or inferiority which began with the slavery.

Education in the early period of colonial rule was designed to impart the rudiments of reading, writing and moral instructions to the blacks. This education which was initially organized by the missionaries underscored the subordinate and acquiescent status of the negroes, vis-a-vis their white masters. Later on, the blacks were tutored in foreign history, literary and musical traditions and even the value system of the Metropolis was imposed wholesale on them.

The blacks responded in several ways, which included the total acceptance of foreign values which pre-supposed a negation of one's racial roots. There was also the rejection of Western values and a nostalgic attachment to vestiges of folk tradition, or, a judicious blend of the best of both cultures. This situation gave rise to the creation of a plural society.

The post-emancipation West Indies was still strongly under foreign domination through colonialism. As a result, there exists in the Caribbean a complex situation created by the existence and interlocking of two different sets of cultural values. There is a foreign derived metropolitan culture which is mostly seen among the upper and middle classes and the black Creole culture which contains many African-derived elements and is practised mainly by the lower classes. Thus, the various social classes act and think differently and one class is elevated and aspired towards, to the detriment of the other. The upper and middle classes speak Standard English, contract legal marriages and practise the religion and culture of their former European

masters. The lower classes on the other hand, generally speak the Creole dialect, engage in fetish practices such as the worship of gods like Shango, gold, and Ifa and usually do not contract legal marriages.

The Caribbean has, therefore, been described as a plural society made up of people displaying different modes of behaviour and who are held together by economic reasons, rather than by a sense of belonging to a common culture. This divisive unity was the result of different responses and modes of adjustment to the void created by dispossession. The slave ancestors had been dispossessed of their motherlands and forced to live in an alien and hostile milieu in which they were made to feel racially and culturally inferior. This deep-seated sense of inferiority and lack of confidence became intensified by the focus of colonial education which encouraged further amnesia and shame about the African past and pushed the blacks towards accepting Europe as good.

There have therefore, been various literary responses to the realities of the Caribbean historical experience. Some writers, especially, white West Indian writers are apologetic about this history. Some reject the West Indies and claim Africa as their spiritual home, while others reject the concept of Africa and take their cues from Europe. The various writers also hold different concepts about West Indian history. They generally act as spokespersons of their society. They analyze and interpret societal ills and consistently endeavour to make the people aware of their endemic shortcomings and seek positive and enduring responses to the milieu.

And so, there is in Caribbean literature the predominance of the alienation theme in various forms: homelessness, rootlessness and exile. It is a situation of being a part of what you could not become. So, the primary cultural commitment of Caribbean writers remains the search for identity and self-discovery. George Lamming describes this situation as paradoxical since it insists on roots and rootlessness; home and homelessness at the same time. The fragmented nature of the society gives the West Indian an acute sense of exile and because the literature of this area reflects and attempts to come to terms with the consequences of colonization, Edward Baugh describes it as "colonial literature", (1978, 13). Caribbean literature then, was to celebrate a new ethos and identity. It established the West Indian identity as different from the European, and neither is it African, Chinese nor Indian but a strange and pleasurable mixture of all these. The writer in the New World then, is engaged in an attempt at articulating a trueness of being.

Implications on Criticism

Bearing the burden of this debilitating history and environment, the criticism of Caribbean literature has often been jaundiced. Primarily, the criticism encapsulates an attitude which sees the visions expressed by the writers as "pessimistic", especially with regard to Naipaul's works. As artistic mediators of their locale and historical experience, the argument seems to have been that the unrelieved gloom of their circumstances, the apparent absence of any controlling moral centre, makes the only logical, possible, realistic portraiture absurd, depressing and hopeless. For instance, commenting on the burden of a depressing West Indian history, Rose Acholonu observes that "the dehumanizing influence of colonization... is as damaging as it is permanent" (1987, 78). An important implication of this observation is the view that the Caribbean man cannot live down the problem of imposed acculturation.

However, contrary to the above assertion, time and events have proved that the Caribbean man can evolve a new image in the modern world out of past and present experiences and thus, transcend his alien environment. The emergence in the first place of Caribbean literature as distinct from European, African, Chinese or Indian literature is a step in the positive direction and shows that the West Indian has a future. As Derek Walcott points out, history is not only that which is celebrated by "ruins of castles and forts but is also the chronicle of the past of the common man and his deeds — the fisherman with his mongrel walking on the beach" (Brodber 1983, 13). Creative history also accounts for the present and projects into the future.

Walcott continues: "you who feel the pain of historylesness, look at the work patterns, the dances, the dreams, the songs and the memories of your forefathers, analyze these and you will be writing your history" (Brodber 1983, 3). Walcott also advises that it is the duty of the West Indian to possess his land, tame and cultivate it and finally produce something original, for the West Indian "behind all his roles and faces, possesses the possibility of a rich, complex and an integrated self which is his by virtue of his exile" (Hirsch 1979, 285). As Gerald Moore notes, "...even if the West Indians had created nothing else, they have certainly created a people" (1969, 8). Walcott insists that it would be abhorrent to him to say "I wish we were English again" or "I wish we were African again", that the reality is that, one has to build in the West Indies (Hirsch 1979, 285).

Walcott's position became vindicated when in 1992 he got the world's highest literary acclaim by winning the Nobel Prize for literature, a feat, which was repeated by Naipaul a few years later. This, apart from being a reward and recognition of individual excellence, is also a celebration of Caribbean literature, and since literature is a celebration of life, the Nobel Prize indirectly proclaims and recognizes Caribbean life as valid and authentic. And so, quite contrary to the claim that history exerts a definitive influence on the creative imagination, it is evident that the Caribbean man can live down the vagaries of history and transcend his alien milieu.

The terms "Caribbean" and "West Indian" are used interchangeably by many people in discussing the literature of this particular portion of the earth. However, "Caribbean" embraces the literature in all the languages of the area — English, French, Spanish and Dutch — but by "West Indian", it is meant only the writings of those Island and Mainland territories where English is the official language and the chief medium of literary composition. In this study, therefore, by "Caribbean" it is meant the literature of the English-speaking Caribbean, otherwise known as West Indian literature.

Major Writers from the Caribbean

While the major writers from the Caribbean are Derek Walcott, Edward Brathwaite, V.S Naipaul, Samuel Selvon, George Lamming, Roger Mais and Michael Anthony, others include V.S. Reid, Orlando Patterson, Earl Lovelace, Jean Rhys, Martin Carter, Geoffrey Drayton, Edgar Mittleholzer, Merle Hodge, Zee Edgell, Alvin Bennett, Errol John, John Hearne, H.D. Delisser, Jacques Roumain, Ian Mcdonald, Joseph Zobel, Denis Williams, Simone Schwarz-Bart, and Glissant Garth St. Orner.

Since Caribbean literature is largely a response by the individual writers to the historical realities of the area, Derek Walcott believes that the West Indian must move towards refashioning the present. The West Indian, Walcott believes must overcome the sense of inferiority and lack of cohesion which is the heritage of dispossession and alienation. Walcott also tackles the issue of the West Indian loyalty to at least two cultures: one, indigenous, and the other, foreign. He maintains that for true nationalism to exist and for the authentic Caribbean personality to emerge, one cannot adopt one culture to the neglect of the other. Walcott consistently blends elements of the two cultures in his works and even attempts to re-evaluate certain aspects of colonial history.

He is also of the belief that servitude to the muse of history can only result in a literature that is sociological, self-pitying and full of revenge. To him, history is fiction which is subject to the vagaries of memory and thus, open to mis-interpretations or re-interpretations. He, therefore, ignores the claim that history exerts a definitive influence on the creative imagination and rather conceives of the New World negro as an Adam who has suffered amnesia of the past and is therefore, free to move forward in time and have a new life for himself in his New World. Poet, dramatist and Nobel laureate for literature, Walcott's publications include: *T-Jean and His Brothers* (1970), *Dream on Monkey Mountain* (1970), The *Sea at Dolphin* (1970) and several volumes of poetry.

Edward Brathwaite, another writer from the Caribbean however, sees the task of the Caribbean writer as being the rehabilitation of the colonial mind through making the West Indian accept folk ways, music and orature and more importantly, shape these things into a tangible literary tradition from which other writers can draw inspiration. Brathwaite believes that the black man who rejects his racial memory is doomed to endless migrations and rootlessness because he can neither define himself in terms of an attachment to Africa, nor in terms of Europe which exploits and manipulates his life. He therefore, suggests very strongly a recapitulation of the past, but since this, according to him might not be easy and will involve the excavation of painful memories, Brathwaite does not hold out any ready or easy solutions for the dispossessed New World black. The *Arrivants* (1973) which is a trilogy is one of his major publications.

Often referred to as the prophet of doom, (Richards 1991, 32), V.S. Naipaul sees the history of the Caribbean as a recurrent void which is characterized by brutality, sterility and lack of visible achievements. According to Naipaul, "history is built on creation and achievement and nothing was created in the West Indies" (1969, 43).

A dominant feature of Naipaul's writing is the presentation and exploration of characters who are either failures because of their inability to express and realize their full potentials, or characters who are charlatans and mediocre but who, nevertheless, are precipitated into success by the sheer mediocrity and formlessness of the society. To Naipaul, the Caribbean is a place which deliberately denies itself his heroes and is incapable of recognizing and nurturing artistic potentials. Also, the diverse groups of people who inhabit the Islands in Naipaul's view, are not bound by any sense of belonging to one culture. As a result, there is the creation of the formless, casual society with haphazard standards and the emergence of the confused, unaccommodated man who is helpless and cast in a sterile and unfriendly landscape. His works include: A Bend in the River (1979), A Flag on the Island (1969), An Area of Darkness (1968), Guerillas (1975), In A Free State (1971), Miguel Street (1974), Mr. Stone and the Knight's Companion (1963), The Mimic Men (1967), The Suffrage of Elvira (1969), The Middle Passage (1969), A House for Mr. Biswas (1969) and The Mystic Masseur (1971). Clearly, Naipaul is the most prolific Caribbean writer.

The direct opposite of Naipaul's vision is Samuel Selvon's. As a writer, Selvon's historical sense is informed by his optimistic vision of man's ability to transcend the drawbacks of a debilitating past, hence, his being referred to as the "optimistic visionary *par excellence"* (Acholonu 1987, 87). Selvon's fictional world centres around the life, customs, beliefs and speech patterns of the peasant West Indian. He reveals the strengths and weaknesses of this world and projects a possible blend of the best of both West Indian and Western ways as the ideal way of coping with a changing contemporary world. Selvon consistently shows that without a fundamental attachment to the beneficial aspects of folkways, the West Indian, whether in Trinidad or abroad is liable to become adrift. He also shows that an inherited sense of racial prejudice is detrimental to progress in the modern world and projects a future in which West Indians will be able to ignore racial differentiations and work for the general good. This vision is conveyed mostly through his fiction which includes: *An Island is a World* (1955), *Moses Ascending* (1984), *Moses Migrating* (1983), *The Lonely Londoners* (1989), *Ways of Sunlight* (1979), *A Brighter Sun* (1979), and *Turn Again Tiger* (1979).

George Lamming's vision is similar to Brathwaite's. Like the latter, Lamming believes that history is continuous and holds salient lessons for the contemporary society and that without a positive recapitulation of the past, the contemporary Caribbean will be unable to respond positively to his milieu. And so, an intimate contact with the past is necessary in order to chart the path of future progress. This vision is conveyed through his *In the Castle of my Skin* (1953).

Roger Mais is another renowned writer from the Caribbean. Mais's fictional world is specifically that of the urban dispossessed in Kingston, Jamaica, but his observations about human life are universal. Accordingly, Mais sets his novels like *The Hills Were Joyful Together* (1953) and *Brother Man* (1974) in

urban slums in Kingston, and exposes the lives of the yard-dwellers in all their stark, squalid, deprived and dehumanized horror: they are rootless, hopeless, brutalized, poor, and have broken homes. They also engage in all forms of moral laxity. At the same time, Mais shows the possibility of the existence of positive emotions and intentions in this world. And so, his fictional world is one of paradoxes in which defeat and success, sloth and industry, piety and lawlessness, caring and hatred exist simultaneously. Mais projects that man is trapped in a tragic world of continuous sufferings and reversals. Man's actions, Mais maintains are without apparent reasons and his fortunes are at the mercy of an abstract, indifferent and often merciless universal force called "fate". But directly contrary to this is the author's conviction that man holds the key to his salvation and that the very existence of the paradoxes of experience testifies to the possibility of man improving himself in the face of tremendous odds. Fundamentally, therefore, Mais's vision is that in their confrontation with an implacable and unpredictable fate, the urban dispossessed of the West Indies need to rely on themselves and seek redemption either from within themselves or within their group.

Another popular writer from the Caribbean is Michael Anthony although his works generally avoid the exploration of contemporary socio-political issues and also rarely reflect a well-defined sense of commitment to the future of the West Indies. In the stories in *Cricket in the Road* (1965) and *The Year in San Fernando* (1973), the author highlights different facets of traditional life in such a way as would imply that he advocates the upholding of the values of this world while grudgingly acknowledging the inevitability of the incursion of Western values. He projects a vision of a traditional and practically untouched West Indies which West Indians must be encouraged to appreciate. Anthony appears to consider the writer's responsibility as being predicated on his obligation to make West Indians aware of the inner beauty and integrity of the traditional milieu. Consequently, his presentation of this world is simplistic, idealistic and precludes any intense critical analysis of the merits or otherwise of traditional life so that while being aware of the inevitability of change, does not appear to be actively engaged in preparing West Indians for the positive and negative repercussions of this change. Ultimately, Anthony's vision centers on the assumption that the attachment to traditional roots, irrespective of their drawbacks is the most viable means of confronting incipient change. He also suggests that the destruction of this traditional way of life or abdication from it would be tantamount to metaphorical death. His other titles include: *Green Days by the River* (1973), *The Games Were Coming* (1977) and *All That Glitters* (1983).

Conclusion

This paper has thus, examined the peculiar history of the Caribbean as well as its attendant effect on its literature and criticism since Caribbean literature is also to some extent, a response by the individual writers to the historical realities of the area. The paper concludes that quite contrary to the assertion that history exerts a definitive influence on the creative imagination (as it is argued by some scholars), the Caribbean man can live down the ravages of history and transcend his alien milieu.

Reference

Acholonu, Rose. "The West Indian Novelist and Cultural Assertion: Samuel Selvon's Artistic Vision". *Black Culture and Black Consciousness in Literature.* E.N. Emenyonu. ed. lbadan: Heinemann, 1987.

Anthony, Michael. *The Year in San Fernando.* London: Heinemann, 1965.

Green Days by the River. London: Heinemann, 1967.

Cricket in the Road. London. Heinemann, 1973.

 All that Glitters. London : Heinemann, 1983.

Baugh, Edward. Introduction to *Critics on Caribbean Literature.* Edward Baugh ed., London: George Allen and Unwin, 1978.

Braithwaite, Edward. *The Arrivants.* London: Heinemann 1973.

Brodber, Erna. "Oral Sources and the Creation of a Social History of the Caribbean". *Jamaica Journal: Quarterly of the Institute of Jamaica.* Vol. 16No. 4, November, 1983.

Figueroa, John. Introduction to *West Indian Poetry,* Vol. 2, London: Evans Brothers Ltd., 1970.

Lamming, George: *In the Castle of My Skin.* London: Michael Joseph, 1953.

Lindo, H.E. Sir Lawrence. "The Commonwealth as seen from the Caribbean". *Commonwealth Journal.* Vol. XII, No.4, August, 1969.

Mais, Roger. *The Hills Were Joyful Together.* London: Heinemann, 1953.

Brother Man. London: Heinemann, 1954.

Naipaul, V.S. *A Bend in the River.* London: Andre Deutsch, 1979.

A Flag on the lsland. London: Penguin Books, 1969.

An Area of Darkness. London: Penguin Books, 1968.

Guerillas. London: Andre Deutsch, 1975.

In A Free State. New York: Andre Deutsch, 1971.

Miguel Street. London: Heinemann, 1974.

Mr. Stone and the Knight's Companion. London: Andre Deutsch, 1963.

The Middle Passage. London: Penguin Books Ltd., 1969.

The Mimic Men. London: Andre Deutsch, 1967.

The Suffrage of Elvira. London: Penguin Books Ltd., 1969.

Richards, David. "West Indian Literature", *Encyclopaedia of Literature and Criticism.* Martin. Coyle and Co. eds. London: Routledge, 1991

Selvon, Samuel. *An Island is a World.* London: Wingate, 1955.

Moses Ascending. London: Heinemann, 1984.

Moses Migrating. London: Longman Group Ltd., 1983.

The Lonely Londoners. London: Longman Group Ltd., 1989.

Ways of Sunlight. London: Longman Group Ltd., 1979.

Walcott, Derek. *Dream on Monkey Mountain and Other Plays*. New York: Giroux, 1970.

Williams, Eric Eustace. *British Historians and the West Indies.* London: Andre Deutsch, 1966.

Implementing Decision Tree Weighted Fuzzy Rules in Decision Support System in Clinical area.

Dr. Anooj P.K.

Department of Information Technology, Al Musanna

anoojpk@gmail.com

Abstract

As people have interests in their health recently, development of medical domain application has been one of the most active research areas. One example of medical domain application is detection system for heart disease based on computer-aided diagnosis methods, were the data are obtained from some other sources and are evaluated based on computer based applications. At the earlier time, the use of computer is to build knowledge based clinical decision support system which uses knowledge from medical experts and transfers this knowledge into computer algorithms manually. This process is time consuming and really depends on medical expert's opinion which may be subjective. To handle this problem, machine learning techniques have been developed to gain knowledge automatically from examples or raw data. Here, a weighted fuzzy rule-based clinical decision support system (CDSS) is presented for the diagnosis of heart disease, automatically obtaining the knowledge from the patient's clinical data. The proposed clinical decision support system for risk prediction of heart patients consists of two phases, (1) automated approach for generation of weighted fuzzy rules, and (2) developing a fuzzy rule-based decision support system. In the first phase, we have used the mining technique, attribute selection and attribute weightage method to obtain the weighted fuzzy rules. Then, the fuzzy system is constructed in accordance with the weighted fuzzy rules and chosen attributes. Finally, the experimentation is carried out on the proposed system using the datasets obtained from the UCI repository and the performance of the system is compared with the neural network-based system utilizing accuracy, sensitivity and specificity.

Keywords:- Clinical Decision Support System (CDSS). Heart disease, Fuzzy logic, Decision tree fuzzy rules, attribute selection, Risk prediction, UCI repository, Accuracy, Sensitivity and Specificity

I. Introduction

To extract hidden patterns and relationships from large databases, Data mining merges statistical analysis, machine learning and database technology [4]. In several areas of medical services, including prediction of effectiveness of surgical procedures, medical tests, medication, and the discovery of relationships among clinical and diagnosis data, Data Mining techniques have been applied [5]. Modern-day medical diagnosis is a very composite process, entailing precise patient data, a philosophical understanding of the medical literature and many years of clinical experience. The healthcare data which, unfortunately, are not "mined" to discover hidden information for effective decision making are collected in a huge amount by the health care industry [2].

Clinical decisions are often taken on the basis of doctors' perception and experience rather than on the knowledge rich data masked in the database [3]. However unfortunately every doctor is not evenly expert in every sub specialty and they are in several places a scarce resource.

Medical care and Reduce costs can be enhanced by a system for automated medical diagnosis [3]. The information afforded by the patients may entail redundant and interrelated symptoms and signs in medical diagnosis especially when the patients suffer from more than one type of disease of same category. The physicians may not be capable to diagnose it accurately [21]. Unfortunately, due to complex interdependence on a variety of factors, accurate diagnosis of disease at a premature stage is quite a challenging task [22].

To enhance health and health care, Clinical Decision Support (CDS) affords clinicians, staff, patients, or other individuals with knowledge and person specific information, intelligently filtered or presented at appropriate times. In enhancing outcomes at a few health care institutions and practice sites, CDS has been effective by making needed medical knowledge readily obtainable to knowledge users [1]. Addressing clinical requirements, such as ensuring accurate diagnoses, screening in a timely manner for preventable diseases, or averting adverse drug events, are the most general exploitations of CDS [6]. Nevertheless, CDS can also potentially lower costs, progress efficiency, and minimize patient inconvenience. In fact, CDS can occasionally deal with all three of these areas simultaneously- for instance, by alerting clinicians to potentially duplicative testing. For more complex cognitive tasks, such as diagnostic decision making, the intention of CDS is to support, rather than to replace, the clinician [7, 8], whereas the CDS may relieve the clinician of the burden of reconstructing orders for each encounter for other tasks (such as presentation of a predefined order set) [9]. The CDS possibly will suggest suggestions, but the clinician ought to filter the information, review the suggestions, and decide whether to take action or what action to take.

Clinical Decision Support Systems are widely categorized into two major groups namely 1) Knowledge based CDSS and 2) Non-knowledge based CDSS [12]. The Knowledge based Clinical Decision Support System comprises rules mostly in the form of IF-Then statements. Generally the data is associated with these rules. For instance, generate warning and more only if the pain intensity is up to a certain level. Generally the knowledge based encloses three main parts - Knowledge base, Inference rules and a mechanism to communicate. To illustrate the result to the users as well as to afford input to the system, Knowledge base holds the rules, inference engine merges rules with the patient data and the communication mechanism is utilized. The adaptive guidelines from a knowledge base server prove to be much more effective than others in certain case, such as of chest pain management [27]. Vagueness, impreciseness and uncertainty are the fundamental and indispensable aspects of knowledge, so as in several practical problems, the experts face vagueness in feature vectors and uncertainty in decision-making. Basically, a symptom is an uncertain indication of a phenomenon since it may or may not occur with it. Especially, uncertainty characterizes a relation between symptoms and phenomena [28, 29].

In almost every stage of a clinical decision making process, Uncertainty occurs. Sources of uncertainties may comprise that patients cannot describe accurately what has happened to them or how they suffer, doctors and nurses cannot explain exactly what they detect, laboratories report outcomes may be with some degrees of error, physiologists do not precisely understand how the human body works, medical researchers cannot precisely characterize how diseases modify the normal functioning of the body, pharmacologists do not understand the mechanisms entirely accounting for the effectiveness of drugs, and no one can precisely determine one's prognosis [25, 26]. Decision Support Systems that are implemented with the support of Artificial Intelligence have the capability to espouse in new environment and to learn with instance [10], [11]. In Computer Aided Support Systems/ Expert Systems, various methods are exploited to congregate information used for the process of Decision making. Statistical Method, Neural Network, Knowledge Based Methods, Fuzzy Logic Rule Based, Genetic Algorithms and more are included in these methods [12]. Since the idea of computer-based CDSSs emerged at first, significant research has been made in both theoretical and practical. Nevertheless numerous obstacles persist to impede the effective implementation of CDSSs in clinical settings, among which representation and reasoning about medical knowledge predominantly under uncertainty are the areas that need refined methodologies and techniques [23, 24]. In the proposed work, we have proposed an effective clinical decision support system using fuzzy logic in which automatically generated weighted fuzzy rules are used. At first, data preprocessing is applied on the heart disease dataset for removing the missing values and other noisy information. Then, using the class label, the input database is divided into two subsets of data that is then used for mining the frequent attribute category individually. Subsequently, the deviation range is computed using these frequent attribute category so as to compute the relevant attributes. Based on the deviation range, the attributes are selected whether any deviation is there or not. Using this deviation range, the decision rules are constructed and these rules are scanned in the learning database to find its frequency. According to its frequency, the weightage is calculated for every decision rules obtained and the weighted fuzzy rules are obtained with the help of fuzzy membership function. Finally, the weighted fuzzy rules are given to the Mamdani fuzzy inference system so that the system can learn these rules and the risk prediction can be carried out on the designed fuzzy system.

II. Related Works

For devising Clinical Decision Support Systems, literature presents a number of researches that have made use of Artificial Intelligence and Data Mining techniques. Among them, to support decision makers in risk prediction of heart disease, a handful of researches have been presented. A few of the significant researches obtainable in the literature are explained below.

Using Dempster-Shafer theory of evidence and fuzzy sets theory, Vahid Khatibi and Gholam Ali Montazer [13] have proposed an inference engine named fuzzy-evidential hybrid inference engine. The hybrid engine functions in two phases. In the initial phase, through fuzzy sets, it models the input information's vagueness. In following, it applies the fuzzy inference rules on the acquired fuzzy sets to generate the first phase results by extracting the fuzzy rule set for the problem. At the subsequent phase, the attained consequences of preceding stage were assumed as basic beliefs for the problem propositions and in this method, the belief and plausibility functions (or the belief interval) are positioned. They have afforded diverse basic beliefs which should be exploited to generate an integrative outcome by gathering information from diverse sources. It has yielded 91.58 percent accuracy rate for its accurate prediction by applying the proposed engine on the Coronary Heart Disease (CHD) risk assessment. The hybrid engine precisely models the information's vagueness and decision-making's uncertainty and through information fusion, affords further accurate results.

For the diagnosis of Coronary Artery Disease (CAD), Markos G. Tsipouras *et al.* [14] have proposed a fuzzy rule-based Decision Support System (DSS). Using a four stage methodology: 1) induction of a

decision tree from the data; 2) extraction of a set of rules from the decision tree, in disjunctive normal form and formulation of a crisp model; 3) transformation of the crisp set of rules into a fuzzy model; and 4) optimization of the parameters of the fuzzy model, the system was automatically generated from an initial annotated dataset. The dataset utilized for the DSS generation and evaluation comprises 199 subjects, each one characterized by 19 features, in addition to demographic and history data, as well as laboratory examinations. Tenfold cross validation was applied, and using the set of rules extracted from the decision tree (first and second stages), the average sensitivity and specificity obtained is 62% and 54%, respectively, while the average sensitivity and specificity increase to 80% and 65%, respectively, when the fuzzification and optimization stages are exploited. Since it was automatically generated, the system suggests numerous advantages, it affords CAD diagnosis based on easily and noninvasively acquired features, and was able to afford interpretation for the decisions made.

For the diagnosis of coronary artery disease based on evidence Noor Akhmad Setiawan *et al.* [15] have developed a fuzzy decision support system. The Coronary Artery Disease data sets obtained from University California Irvine (UCI) are utilized. By using rules extraction method based on Rough Set Theory, the knowledge base of fuzzy decision support system was taken. Based on information from discretization of numerical attributes, the rules then were selected and fuzzified. Using the information from support of extracted rules, Fuzzy rules weight was proposed. To verify the proposed system, UCI heart disease data sets collected from U.S., Switzerland and Hungary, data from Ipoh Specialist Hospital Malaysia is used. The results revealed that the system was capable to provide the percentage of coronary artery blocking better than cardiologists and angiography. The consequences of the proposed system were verified and authenticated by three expert cardiologists.

To investigate factors that contribute significantly to enhancing the risk of acute coronary syndrome Tahseen A. Jilani *et al.* [16] have utilized data mining techniques. They have presupposed that the dependent variable was diagnosis – with dichotomous values showing presence or absence of disease. They have applied binary regression to the factors distressing the dependent variable. The data set has been obtained from two diverse cardiac hospitals of Karachi, Pakistan. They have total sixteen variables out of which one was presupposed dependent and other 15 are independent variables. Data Reduction techniques like principle component analysis was applied for better performance of the regression model in predicting Acute Coronary Syndrome. They have considered only 14 out of sixteen factors on the basis of data reduction results.

Using neural network, Shantakumar B. Patil and Y.S. Kumaraswamy [17] have proposed an intelligent and effective heart attack prediction system. For the extraction of significant patterns from the heart disease warehouses for heart attack prediction, a proficient methodology has been proposed. Initially, in order to make it suitable for the mining process, the data warehouse was pre-processed. Once the preprocessing gets ended, the heart disease warehouse was clustered with the support of the K-means clustering algorithm, which will extract the data appropriate to heart attack from the warehouse. Consequently with the aid of the MAFIA algorithm from the data extracted, the frequent patterns applicable to heart disease are mined. In addition, on basis of the computed significant weight age, the patterns vital to heart attack prediction are selected. For the effectual prediction of heart attack, the neural network was trained with the preferred significant patterns. With Back-propagation as the training algorithm, they have employed the Multi-layer Perceptron Neural Network. The consequences thus attained have illustrated that the designed prediction system was skilled of predicting the heart attack efficiently.

A prototype Intelligent Heart Disease Prediction System (IHDPS) has been developed by Sellappan Palaniappan and Rafiah Awang [18] using Data Mining techniques, namely, Decision Trees, Naive Bayes and Neural Network. Results exposed that in realizing the objectives of the defined mining goals, each

technique has its exclusive strength. IHDPS can respond complex "what if" queries whereas traditional decision support systems is unable to answer. It can foretell the possibility of patients getting a heart disease, using medical profiles such as age, sex, blood pressure and blood sugar. It facilitates significant knowledge, e.g. patterns, relationships between medical factors related to heart disease, to be recognized. IHDPS is Web-based, user-friendly, scalable, reliable and expandable.

To utilize Artificial Intelligence tools as a clinical decision support in assessing cardiovascular risk in patients Beatrice Fidele *et al.* [19] have presented a research study. In the proposed artificial neural network, a two-layer neural network employing the Levenberg-Marquardt algorithm and the resilient back propagation have been utilized. It has been shown by exploiting the Long Beach dataset, how this network was efficient in predicting cardiovascular risk in individual patients. At an individual level the application of the network seems to better deal with the prediction of cardiovascular disease.

The ability of fuzzy neural network model to predict the likelihood of coronary heart disease has been evaluated by Basir Abidin *et al.* [20] for individuals based on knowledge of their biomarkers, risk habits and demographic profiles. The prediction performance of fuzzy neural network models were calculated in terms of percentage accuracies and compared with the prediction performance of logistic regression models. Provisionary consequences have illustrated that for the prediction of coronary heart disease in the sample studied, four markers namely body mass index, systolic blood pressure, total cholesterol level, and age are the appropriate markers. Fuzzy neural network models prediction performance were found to be sophisticated to the logistic regression performance in addition to other outcomes that are reported in related literature.

III. Discussion of Heart Disease Dataset

A. Heart Disease

Heart disease refers to numerous problems that distress the heart and the blood vessels in the heart. Coronary artery disease (CAD), Angina, Heart attack and Heart failure are some examples for the diverse types of heart diseases. Coronary heart disease (CHD) is a key reason of sickness and death in the modern society. The expense of handling of CHD is a major economic load and so prevention of coronary artery disease is an extremely essential step in the management. Some of the several methods that can be used for CHD prevention include health promotion activities, special protection schemes, programs to change way of living, identification in advance and excellent control of risk factors and continuous observation of arising risk factors [32]. Amassment of plaques inside the walls of the coronary arteries that deliver blood to the myocardium causes CAD. Damage to myocardium may result due to the continued temporary oxygen deprivation that may be caused by CAD [15]. The term 'cardiovascular disease' that represents a category of heart disease comprises a broad variety of conditions that upset the heart and the blood vessels and the way in which blood is pumped and circulated in the body [34]. CHD is caused by the decreased blood and oxygen supply to the heart due to the narrowing of the coronary arteries. CHD includes myocardial infarctions, commonly called as a heart attacks, and angina pectoris, or chest pain [17]. Heart attack results due to the abrupt blockage of a coronary artery, usually because of a blood clot. Insufficient blood flow to the heart muscles results in chest pains [35]. There are several types of cardiovascular disease such as high blood pressure, coronary artery disease, valvular heart disease, stroke, or rheumatic fever/rheumatic heart disease [36].

B. Dataset Description

The data set is taken from Data Mining Repository of University of California, Irvine (UCI) [31]. Finally the system is validated using data sets from Cleveland, Hungarian and Switzerland.

(1) Cleveland data. Robert Detrano, M.D., Ph.D. collected these data at V.A. Medical centre. All published experiments relate to using a subset of 14 of the 76 attributes present in the processed Cleveland Heart Disease database. Specifically, ML researchers use only the Cleveland database till today. The existence of heart disease in the patient is indicated in the "goal" field by means of an integer that can take any value from 0 (no presence) to 4. Distinguishing disease existence (values 1, 2, 3, 4) from non-existence (value 0) has been the focus of the experiments conducted on the Cleveland database [30]. Six of the examples have been discarded because they had missing values. Class distributions are 54% heart disease absent, 46% heart disease present.

(2) Hungarian data. Andras Janosi, M.D. collected these data at the Hungarian Institute of Cardiology, Budapest. Due to a huge percentage of missing values three of the attributes have been discarded but the format of the data is exactly the same as that of the Cleveland data. 34 examples of the database were discarded on account of missing values and 261 examples were present. Class distributions are 62.5% heart disease absent and 37.5% heart disease present [33].

(3) Switzerland data. William Steinbrunn, M.D collected these data at the University Hospital, Zurich, Switzerland. Switzerland data has more number of missing values.

IV. An Efficient Clinical Decision Support System to Risk Level Prediction of Heart Disease

Normally, directly support clinical decision making is the intention behind the design of a clinical decision support system and it presents patient-specific assessments or recommendations produced using characteristics of individual patients to clinicians for consideration [38]. In recent years, clinical decision support system based on computer-aided diagnosis methodologies have been proposed in the literature which by evaluating the data obtained by some of the methods or other sources (i.e., laboratory examinations, demographic and/or history data, etc.) from a computer-based application leads to a computer-aided diagnosis. The data analysis methods used in most of the proposed methods cannot provide clear and direct explanation for the decisions made to examine the risk factors for cardiovascular diseases as they are based on neural networks. Hence, a method based on easily obtained features capable of calculating the risk level of computer-aided diagnosis and providing explanation for the decisions made would be of immense clinical value [14]. So, the soft computing technique in particular the fuzzy logic technique could be used for assessing the risk level of heart patients in developing the clinical decision support system of heart disease diagnosis.

In the proposed system, the biomarkers for cardiovascular diseases described in the literature are age, sex, total cholesterol level, HDL, LDL, age, smoking status, hypertension, and pre-eclampsia that are mainly used to predict the risk level of heart patients. For better prediction of risk level, we make use of fuzzy logic, where the decision to be taken for the heart disease of patients is based on the weighted fuzzy rules. By considering the CDSS based on fuzzy logic, the efficiency is mainly depends on the fuzzy rules employed in the system. In general, the domain experts or professionals in the corresponding domain provide the fuzzy rules for prediction problem. But, here, we automatically generated the fuzzy rules to provide the better learning of fuzzy system using historic data. In addition to, the fuzzy rules are weighted in accordance with their importance using the attribute weightage. These weighted fuzzy rules are applied on the rule base of the fuzzy system and then the prediction can be carried out on the designed fuzzy-based CDSS. The detailed steps involved in the proposed clinical decision support system are explained in the following figure 1 and figure 2.

A. Data preprocessing

The purpose of data preprocessing is to extract useful data from raw heart disease datasets and then these data should be converted into the format necessary for prediction of risk level. Due to the irrelevant

information in the heart disease datasets, the original raw data cannot be directly used in the prediction procedure, hence in data preprocessing phase, raw data need to be cleaned, analyzed and transformed for further step. So, the irrelevant attributes and information in the raw data are identified and it is converted into the row-column format after removing the irrelevant one. Here, each row represents the patient information and the column indicates a list of attributes (biomarkers). The last column gives the class label that corresponds to the risk level of the heart patients.

B. Classification of training dataset based on risk level

After data processing, the input training dataset used for prediction is classified into two subsets of data based on the class label described in the data. The input training dataset consists of two class labels, in which '0' indicates that the disease status is less than 50% and '1' represent that the risk level for heart disease is more than 50%. Using these two class label, the dataset (D_H) is divided into two subsets of data, $D_H = \{D_{Hj} ; 1 \le j \le 2\}$, where, j denotes the class label that describes the risk level of patients. In addition to, each class contains m number of attributes and each attributes (β_i) presented in the dataset consists of attribute category that is the continuous symbolic value specified for every patients. The two subsets of data D_{Hj} obtained are then employed for generating a better set of weighted fuzzy rules automatically so that the fuzzy system can learn the rules effectively.

C. Automated approach to generate decision tree rules

This section describes the automated approach to generate the weighted fuzzy rules from the classified dataset in order to effectively learn the fuzzy system. By considering the heart disease datasets, a large number of attributes is presented but, the extraction significant attributes exactly suitable for prediction is very important. In order to choose the most relevant and important attributes, we have used the frequent attribute category that is mined from the input datasets. Then, based on the frequency of attribute category and the weightage of attributes, the fuzzy rules are generated automatically. The steps to be used for automatic generation of fuzzy rules are discussed in this sub-section.
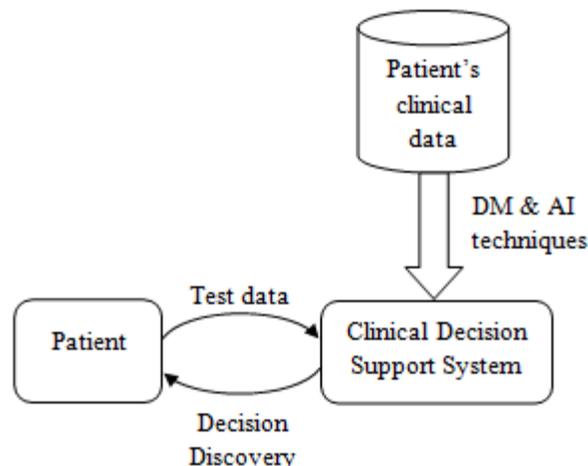

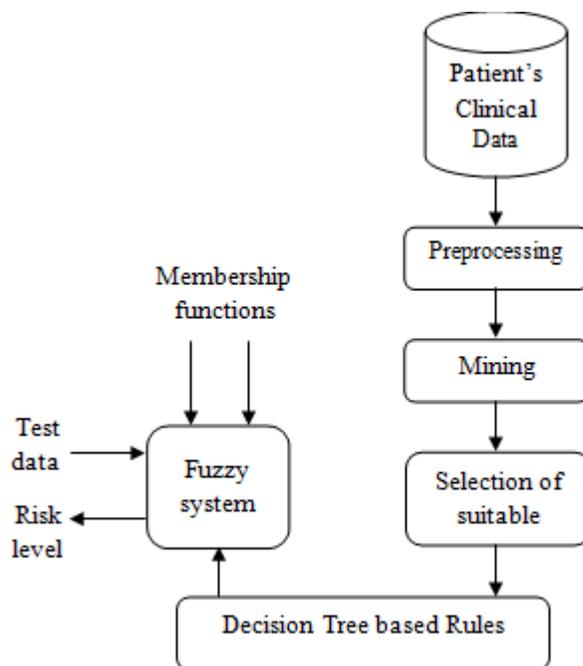**Fig. 1.** Clinical decision support system

Fig. 2. Proposed fuzzy-based clinical decision support system

(1) Mining of attribute category

In this step, the frequent attribute category corresponds to every attributes β_i presented in the datasets D_{Hj} should be mined so that the frequency of every attribute category within the class C_j is obtained by scanning the database. Here, the well known algorithms, such as Apriori [40] and FP-growth [37] are not suitable for mining of the frequent attribute category because these data format is different from the data that are suitable for traditional algorithms. Here, we simply mine the one length attribute category by finding the frequency in the database and then, the attribute category of the attributes β_i within the class C_j are arranged in accordance with their frequency. Then, for every attributes, a set of attribute category are selected from the sorted list based minimum support. The selected attribute category is then stored in a two vector, $V_{MIN}{}^j$ and $V_{MAX}{}^j$ for each class, in which one vector contains the minimum value corresponds to the attribute category of every attribute and second vector contains the maximum value corresponds to the attribute category of every attribute. It is denoted as, $V_{MIN}{}^j = \{\beta_{\min 1}, \beta_{\min 2}, ..., \beta_{\min m}\}$ and $V_{MAX}{}^j = \{\beta_{\max 1}, \beta_{\max 2}, ..., \beta_{\max m}\}$.

(2) Selection of suitable attributes

Here, the suitable attributes is then identified employing the two vectors, $V_{MIN}{}^j$ and $V_{MAX}{}^j$ obtained from the previous step. The reason behind this step is that the input data contains a large number attributes, in which all the attributes are not so effective in predicting risk level of heart patient. So, the identification of suitable attributes should ensure the better accuracy in risk level prediction. For identifying the suitable attributes, we have used deviation method, where mined 1-length attribute category is used. The deviation range for the entire element presented in the minimum vector of two classes, $V_{MIN}{}^1$ and $V_{MIN}{}^2$ is identified by performing the one-to-one comparison of respective location. Similar way, the deviation range can be

20

identified for the two maximum vectors of two classes, $V_{MAX}{}^1$ and $V_{MAX}{}^2$. The minimum and maximum deviation vector thus obtained is represented as, D_{MAX} and D_{MIN}. Then, the suitable attributes are chosen if the deviation is found out, otherwise it is eliminated. The effective attributes selected for rule generation process is represented as, $A = \left\lfloor \beta^{(1)}, \beta^{(2)}, \cdots, \beta^{(k)} \right\rfloor$, Where, $k \leq m$.

(3) Generation of decision rules and rule weighting

Rule generation and rule weighting is an important step for developing fuzzy-based clinical decision support system. The deviation vector, D_{MAX} and D_{MIN} obtained from the previous step is employed here to generate the decision rules that specified the risk level of heart patients in terms of numerical variables. The rules are generated automatically from the two deviation vectors that contain the deviation of each attributes comparing two classes. From the equal size deviation vector, three decision rules are generated from every element by comparing the corresponding elements of both vectors. Suppose, assume that the first element of the vector, D_{MIN} and D_{MAX} is '3' and '8', the corresponding generated decision rules are, "IF $\beta^{(1)}$ is less than 3, THEN the risk is less than 50" and "IF $\beta^{(1)}$ is greater than 8, THEN the risk is greater than 50" and "IF $\beta^{(1)}$ is in between the 3 and 8, THEN the risk is either less than 50 or greater than 50". These rules are then weighted based on the importance level of it in the database D_H. For each rule generated, we find the number of patients (M) satisfy these rules by scanning the database D_H. Once we find the value of 'M' for the rule $(R_1 \rightarrow R_2)$, the weightage of the rule is found by using the following formulae,

$$W(R_1 \rightarrow R_2) = \frac{M^{(R_1 \rightarrow R_2)}}{N}$$

Where, $M^{(R_1 \rightarrow R_2)}$ → Number patients who satisfy the rule, $R_1 \rightarrow R_2$

N → Total number of patients in the database

(4) Finding weighted fuzzy rules and decision tree rules

The extremely important task of generating fuzzy rules from the data described using numeric-symbolic values appears to be extremely difficult. Handling this type of values is extremely important because it is very close to human knowledge and rules with such values are normally more comprehensible and accountable when compared to rules with numerical values. Handling such values is permitted by the introduction of fuzzy set theory which by the construction of fuzzy leads to the generation of a set of fuzzy rules. The automatic method proposed here is based on the construction of fuzzy modalities that enables to generate fuzzy values from a set of rules with numerical values. The decision rules obtained from the previous contain IF and THEN part, in which IF part specifies the numerical variable and THEN part specifies the class label. At first, the numerical variable specified in the IF part of the decision rules is converted into the linguistic variable according to the fuzzy membership function and THEN part of the fuzzy rules is similar to that of decision rules. For example, "IF $\beta^{(1)}$ is LOW, THEN the risk is less than 50 (class '0') and "IF $\beta^{(1)}$ is MEDIUM, THEN the risk is either less than 50 or greater than 50 (class '0' or '1') and "IF $\beta^{(1)}$ is HIGH, THEN the risk is greater than 50 (class '1')". Similar way, we process entire decision rules with numeric variable and they are converted into the fuzzy rules using membership function. A group

of fuzzy IF-THEN rules obtained is belonging to one of the most popular, most effective, and user-friendliest knowledge representations so as to provide the effective learning for fuzzy system.

D. Developing clinical decision support system using fuzzy logic

This section describes the developing of clinical decision support system using fuzzy logic system for assessing the risk level of heart patient. Fuzzy logic introduced by Zadeh in the late 1960s [39] is the rediscovery of multi-valued logic designed by Lukasiewicz. A fuzzifier, fuzzy rules, fuzzy inference engine and defuzzifier exists in a fuzzy logic model. *Fuzzifier:* Firstly, fuzzy linguistic variables, fuzzy linguistic terms and membership functions are used to convert a gathered crisp set of input data into a fuzzy set. This step is known as fuzzification. Enabling interpretation of fuzzy condition in a rule is the purpose of the fuzzification process. *Fuzzy rule base:* The fuzzy rules that are important for any fuzzy system are defined after the inputs are fuzzified. A fuzzy rule contains a condition and a conclusion and its structure is similar to the IF-THEN rule. An entire fuzzy rule that is created to control the output variable exists in the rule base. *Inference engine:* Subsequently, a set of rules defined in the fuzzy rule base is used as the basis for interpreting and by employing reasoning fuzzy outputs are generated. *Defuzzifier:* A fuzzy set (the aggregate output fuzzy set) is used as the input for the defuzzification process and membership functions based mapping of fuzzy sets to a crisp output is used to obtain a single number as the output. The general structure of the fuzzy logic system is shown in figure 4.

The designed clinical decision support system shown in figure 3 contains 'm' inputs and one output, where inputs are related to the 'm' attributes and output is related to the class label (risk level). Here, m-input, single-output of Mamdani fuzzy inference system with centroid of area defuzzification strategy was used for this purpose. Here, each input fuzzy set defined in the fuzzy system includes four membership functions (VL, L, M and H) and an output fuzzy set contains two membership functions (L and H). Each membership function used triangular function for fuzzification strategy. The fuzzy rule base contains the set of weighted fuzzy rules obtained from the proposed procedure to learn the system.

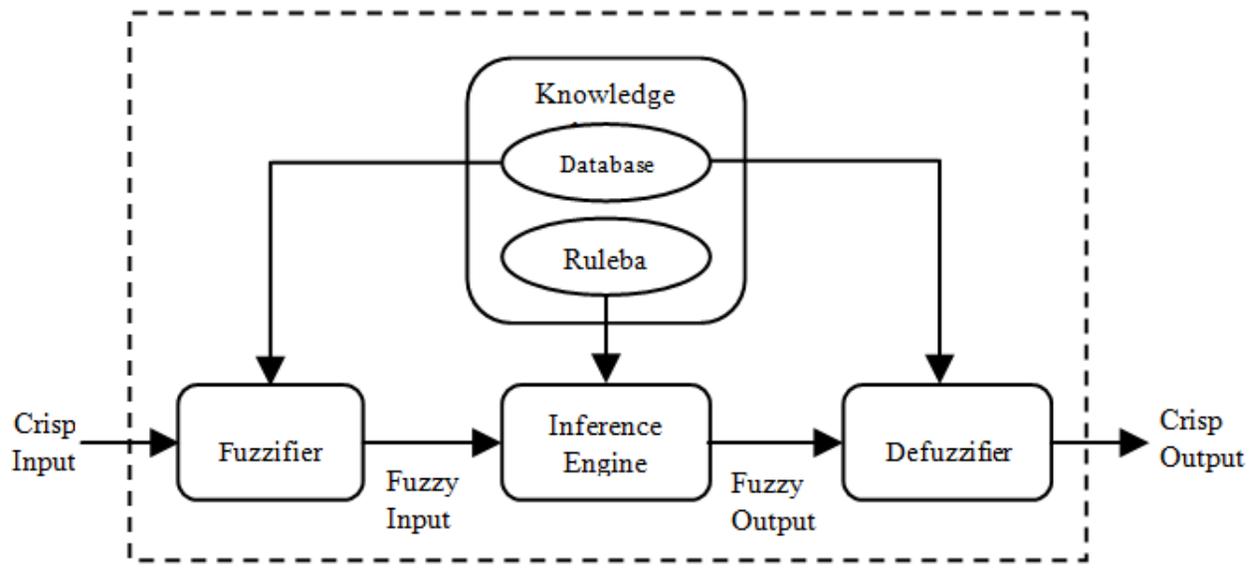**Fig. 3.** Designed fuzzy inference system based on weighted fuzzy rules

Fig 4. Fuzzy inference system
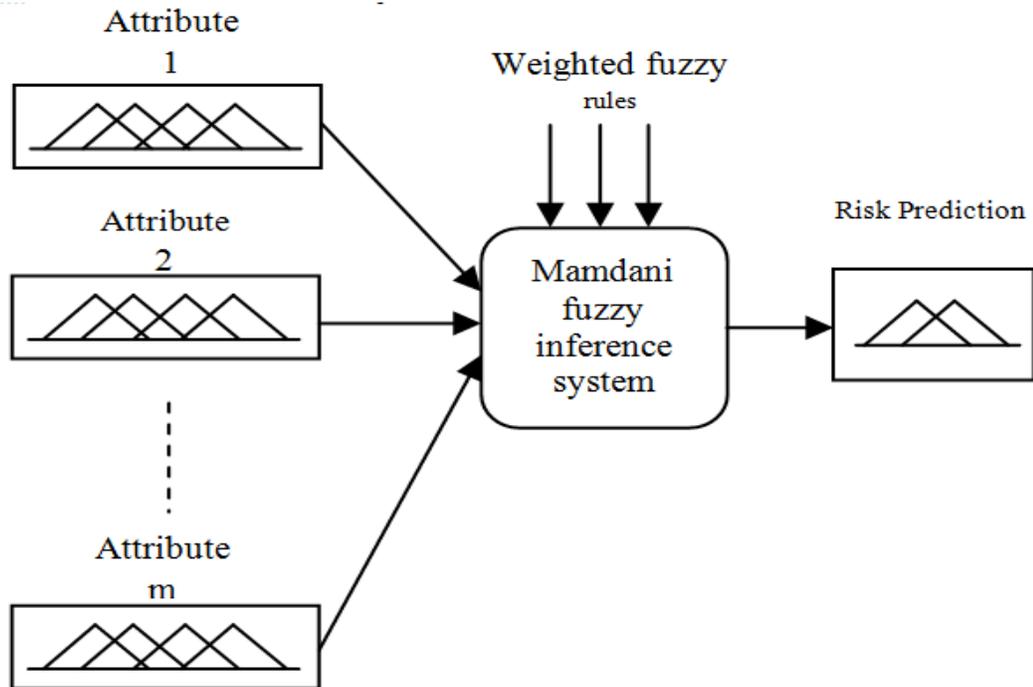
V. Results and Discussion

The proposed fuzzy logic-based clinical decision support system has been implemented using MATLAB (7.10).

The experimental results of the clinical decision support system for risk prediction are explained in this section. Here, the performance of the proposed system is compared with the neural network-based system to evaluate the sensitivity, specificity and accuracy.

A. Experimental environment and datasets

For experimentation, we have taken Cleveland, Hungarian and Switzerland heart disease dataset [41] which is a widely-accepted database obtained from UCI machine learning repository. The heart disease dataset are divided into two sets such as, (1) Training dataset (2) Testing dataset. The training dataset is used to generate the weighted fuzzy rules and the testing dataset is used to analyze the performance of the proposed system. Table 1 provides the description of these datasets.

Table.1. Details of datasets

	Total instance	Training Data	Testing Data
Cleveland	303	202	101
Hungarian	294	196	98
Switzerland	123	82	41

B. Selected attributes for risk level prediction

At first, the suitable attributes are chosen from the training dataset using the proposed approach and then, the fuzzy rules are generated based on the chosen attribute. The attributes chosen by the proposed system for risk prediction is given in   table 2.

23

Table. 2. Selected attributes for fuzzy rule generation

Datasets	Selected attributes
Cleveland	Age, Trestbps (resting blood pressure), Chol (serum cholestoral in mg/dl), Thalach (maximum heart rate achieved), Oldpeak (ST depression induced by exercise relative to rest), Thal.
Hungarian	Age, Trestbps, Chol, Restecg (resting electrocardiographic results), Thalach, Exang (exercise induced angina), Oldpeak, Slope (slope of the peak exercise ST segment).
Switzerland	Age, Sex, Cp (chest pain type), Trestbps, Fbs (fasting blood sugar), Restecg, Thalach, Oldpeak, Slope, Ca (number of major vessels), Thal.

C. Performance analysis

In testing phase, the testing dataset is given to the proposed system to find the risk prediction of heart patients and obtained results is evaluated with the evaluation metrics namely, sensitivity, specificity and accuracy [42]. In order to find these metrics, we first compute some of the terms like, True positive, True negative, False negative and False positive based on the definitions given in table 3.

$$Sensitivity = TP/(TP + FN)$$

$$Specificity = TN/(TN + FP)$$

$$Accuracy = (TN + TP)/(TN + TP + FN + FP)$$

Where, $TP \rightarrow$ True positive

$TN \rightarrow$ True negative

$FN \rightarrow$ False negative

$FP \rightarrow$ False positive

Table. 3. Terms used to define sensitivity, specificity and accuracy

Outcome of the diagnostic test	Condition (e.g. Disease) As determined by the Standard of Truth		
	Positive	Negative	Row Total
Positive	TP	FP	TP+FP (Total number of subjects with positive test)
Negative	FN	TN	FN + TN (Total number of subjects with negative test)
Column total	TP+FN (Total number of subjects with given condition)	FP+TN (Total number of subjects without given condition)	N = TP+TN+FP+FN (Total number of subjects in study)

The evaluation metrics are computed for both training and testing dataset in the testing phase and the obtained result for Cleveland, Hungarian and Switzerland datasets are given in the following tables. Table 4 shows the overall performance of the proposed system in risk prediction, in which, class 0 indicates that the risk level is below the 50% and class 1 indicates the risk level is above 50%.

Table. 4. The performance of the proposed clinical decision support system in risk prediction

Datasets	Class	Metric	Proposed System	
			Training	Testing
Clevaland	<50%	Accuracy	0.509901	0.623529
		Sensitivity	0.724771	0.765957
		Specificity	0.258065	0.447368
	>50%	Accuracy	0.509901	0.623529
		Sensitivity	0.258065	0.447368
		Specificity	0.724771	0.765957
Hungarian	<50%	Accuracy	0.715054	0.469388
		Sensitivity	0.8	0.31746
		Specificity	0.540984	0.742857
	>50%	Accuracy	0.715054	0.469388
		Sensitivity	0.540984	0.742857
		Specificity	0.8	0.31746
Switzerland	<50%	Accuracy	0.364706	0.512195
		Sensitivity	0.625	0.333333
		Specificity	0.337662	0.526316
	>50%	Accuracy	0.364706	0.512195
		Sensitivity	0.337662	0.526316
		Specificity	0.625	0.333333

D. Comparative study

The performance was analyzed with three different heart disease datasets. The results obtained from these datasets are given in the sub-section 5.3. Here, we compare the performance of the proposed CDSS in risk prediction with the neural network-based system using these datasets. The results obtained for these three datasets are given in the following figures. By analyzing the plotted graphs, the performance of the proposed clinical support system has significantly improvement compared with the neural network.

Fig. 5. Risk prediction for the patients who comes under below 50% (a) Training dataset (b) Testing dataset

Fig. 6. Risk prediction for the patients who comes under above 50% a) Training dataset (b) Testing dataset

Fig. 7. Risk prediction for the patients who comes under below 50% (a) Training dataset (b) Testing dataset
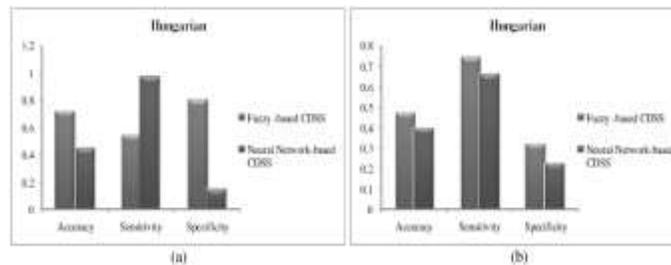
Fig. 8. Risk prediction for the patients who comes under above 50% a) Training dataset (b) Testing dataset
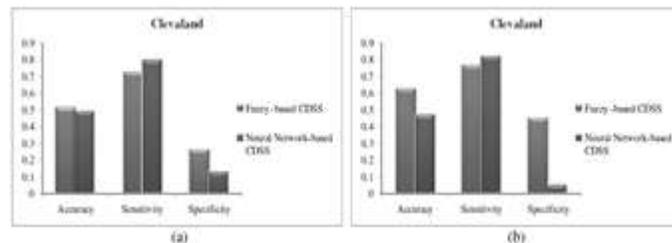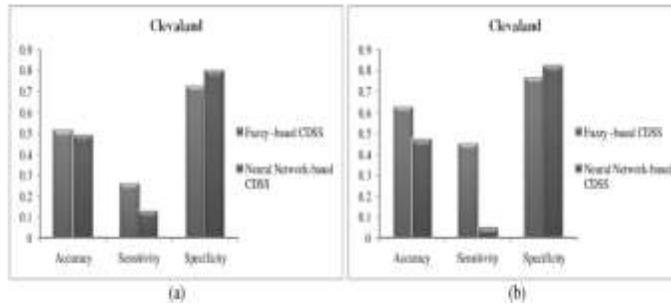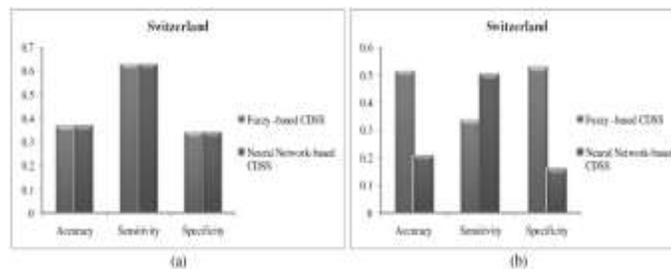

Fig. 9. Risk prediction for the patients who comes under below 50% (a) Training dataset (b) Testing dataset
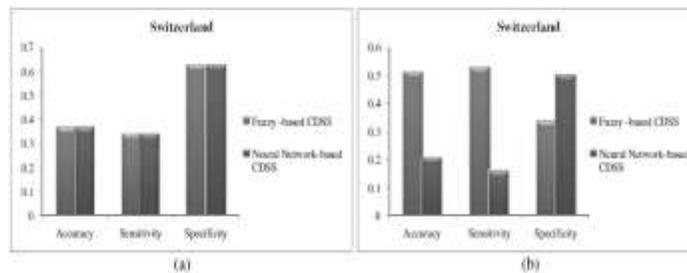
Fig. 10. Risk prediction for the patients who comes under above 50% a) Training dataset (b) Testing dataset
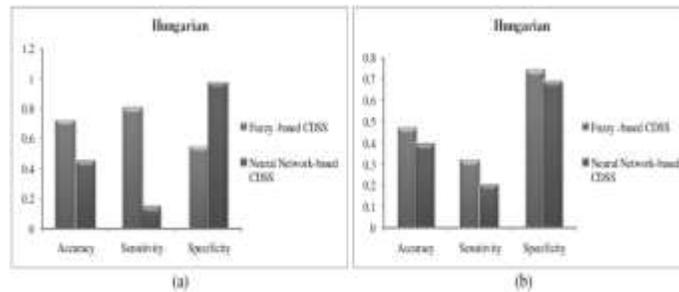
26

VI. Conclusion

We have presented a weighted fuzzy rule-based clinical decision support system (CDSS) for computer-aided diagnosis of heart disease. The automatic procedure to generate the fuzzy rules is an advantage of the proposed system and the weighted procedure introduced in the proposed work is additional advantage for effective learning of the fuzzy system. The proposed clinical decision support system for risk prediction of heart patients contains two steps such as, (1) generation of weighted fuzzy rules, and (2) developing of a fuzzy rule-based decision support system. Here, the suitable attribute were generated after applying the mining procedure and these attributes were used to generate the fuzzy rule that are then weighted based on the frequency in the learning datasets. These weighted fuzzy rules were used to build the clinical decision support system using Mamdani fuzzy inference system. Finally, the experimentation was carried out on the UCI machine learning repository and the results in risk prediction ensured that the proposed clinical decision support system was improved significantly compared with the network-based system in terms of accuracy, sensitivity and specificity.

References

[1] George K. Merijohn, James D. Bader, Julie Frantsve-Hawley, Krishna Aravamudhan, "Clinical Decision Support Chairside Tools for Evidence-Based Dental Practice", The Journal of Evidence-Based Dental Practice, Elsevier, Vol: 8, No: 3, pp: 119-132, 2008.

[2] Sellappan Palaniappan, Rafiah Awang, "Intelligent Heart Disease Prediction System Using Data Mining Techniques", IJCSNS International Journal of Computer Science and Network Security, Vol 8, No: 8, pp: 108-115, 2008.

[3] Latha Parthiban and R. Subramanian, "Intelligent Heart Disease Prediction System using CANFIS and Genetic Algorithm", International Journal of Biological, Biomedical and Medical Sciences, Vol: 3, No: 3, 2008.

[4] Thuraisingham, B.: "A Primer for Understanding and Applying Data Mining", IT Professional, pp: 28-31, 2000.

[5] Tzung-I Tang, Gang Zheng, Yalou Huang, Guangfu Shu, Pengtao Wang, "A Comparative Study of Medical Data Classification Methods Based on Decision Tree and System Reconstruction Analysis", IEMS, Vol. 4, No. 1, pp. 102-108, 2005.

[6] Garg AX, Adhikari NKJ, McDonald H, et al., "Effects of computerized clinical decision support systems on practitioner performance and patient outcomes", Journal of the American Medical Association, Vol: 293, No: 10, pp: 1223-38, 2005.

[7] Miller RA. Why the standard view is standard: people, not machines, understand patients' problems, J Med Philos, Vol: 15, No: 6, pp: 581-91, 1990.

[8] Miller RA, Masarie FE, Jr. The demise of the "Greek Oracle" model for medical diagnostic systems, Methods Inf Med., Vol: 29, No: 1, pp: 1-2, 1990.

[9] Osheroff JA. Improving medication use and outcomes with clinical decision support: a step-by-step guide. Chicago, IL: The Healthcare Information and Management Systems Society; 2009.

[10] J. Warren, G. Beliakov, B. Zwaag, " Fuzzy logic in clinical practice decision support system." in Proceedings of the 33rd Hawaii International Conference on System Sciences, 2000.

[11] J. Anderson, "Clearing the Way for Physicians' Use of Clinical Information Systems." Communication of the ACM, pp: 83 – 90, 1997.

[12] M.M.Abbasi, S. Kashiyarndi, "Clinical Decision Support Systems: A discussion on different methodologies used in Health Care", 2006.

[13] Vahid Khatibi, Gholam Ali Montazer, "A fuzzy-evidential hybrid inference engine for coronary heart disease risk assessment", Expert Systems with Applications, Vol: 37, No: 12, pp: 8536-8542, 2010.

[14] Markos G. Tsipouras, Themis P. Exarchos, Dimitrios I. Fotiadis, Anna P. Kotsia, Konstantinos V. Vakalis, Katerina K. Naka, and Lampros K. Michalis, "Automated Diagnosis of Coronary Artery Disease Based on Data Mining and Fuzzy Modeling", IEEE Transactions on Information Technology in Biomedicine, Vol: 12, No: 4 , pp: 447 - 458, 2008.

[15] Noor Akhmad Setiawan, P.A. Venkatachalam and Ahmad Fadzil M.Hani, "Diagnosis of Coronary Artery Disease Using Artificial Intelligence Based Decision Support System", in Proceedings of the International Conference on Man-Machine Systems (ICoMMS), Batu Ferringhi, Penang, 2009.

[16] Tahseen A. Jilani, Huda Yasin, Madiha Yasin, Cemal Ardil, "Acute Coronary Syndrome Prediction Using Data Mining Techniques- An Application", World Academy of Science, Engineering and Technology, Vol: 59, 2009.

[17] Shantakumar B.Patil, Y.S. Kumaraswamy, "Intelligent and Effective Heart Attack Prediction System Using Data Mining and Artificial Neural Network", European Journal of Scientific Research, Vol. 31 No. 4, pp. 642-656, 2009.

[18] Sellappan Palaniappan, Rafiah Awang, "Intelligent Heart Disease Prediction System Using Data Mining Techniques", International Journal of Computer Science and Network Security, Vol.8, No.8, pp: 343 -350, 2008

[19] Beatrice Fidele, Jayrani Cheeneebash, Ashvin Gopaul and Smita S.D. Goorah, "Artificial Neural Network as a Clinical Decision-Supporting Tool to Predict Cardiovascular Disease", Trends in Applied Sciences Research, Vol: 4, No: 1, pp: 36-46, 2009.

[20] Basir Abidin, Rosma Mohd Dom, A Rashid A Rahman, Roselina A Bakar, "Use of Fuzzy Neural Network to Predict Coronary Heart Disease in a Malaysian Sample", in Proceedings of the 8th WSEAS International Conference on Telecommunications and Informatics, 2009.

[21] D.Shanthi, Dr.G.Sahoo, Dr.N.Saravanan, "Input Feature Selection using Hybrid Neuro-Genetic Approach in the Diagnosis of Stroke Disease", IJCSNS International Journal of Computer Science and Network Security, Vol.8, No.12, 2008.

[22] Hongmei Yan, Jun Zheng, Yingtao Jiang, Chenglin Peng, Qinghui Li, "Development of a decision support system for heart disease diagnosis using multilayer perceptron", Proceedings of the 2003 International Symposium on Circuits and Systems, Vol 5, pp: 709-712, 2003.

[23] L. Lin, P. J.-H. Hu, O. R. Liu Sheng, "Decision Support Systems", Vol: 42, 2006.

[24] M. Musen, Y. Shahar, E. Shortliffe, in Biomedical Informatics. pp. 698- 736, 2006.

[25] P. Szolovits, "Methods of Information in Medicine", Vol: 34, pages: 111, 1995.

[26] Guilan Kong, Dong-Ling Xu and Jian-Bo Yang, "Clinical Decision Support Systems: A Review On Knowledge Representation And Inference Under Uncertainties", International Journal of Computational Intelligence Systems, Vol.1, No. 2, pp: 159-167, 2008.

[27] S. Ali, P Chia, K. Ong." Graphical Knowledge-Based Protocols for Chest Pain Management.", Computer in Cardiology, 1999, IEEE, pages 309 - 312.

[28] E. Straszecka, "Combining uncertainty and imprecision in models of medical diagnosis," Information Sciences, Vol.176, pp. 3026–3059, 2007.

[29] S. K. De, A. Biswas, and R. Roy, "An application of intuitionistic fuzzy sets in medical diagnosis," Fuzzy Sets and Systems, vol. 117, pp. 209- 213, 2001.

[30] E.P.Ephzibah, "Cost Effective Approach on Feature Selection using Genetic Algorithms and LS-SVM Classifier", IJCA Special Issue on "Evolutionary Computation for Optimization Techniques", ECOT, 2010

[31] D. J. Newman, S. Hettich, C. L. Blake, and C. J. Merz, "UCI Repository of machine learning databases," University California Irvine, Department of Information and Computer Science, 1998.

[32] Knopp RH., "Risk factors for Coronary artery disease in women", Am. J. Cardiol., Vol: 89, No: 12A, pp: 28-34, 2002.

[33] Andrew p. Bradley, "The use of the area under the roc curve in the evaluation of machine learning algorithms", Pattern Recognition, Vol. 30, No. 7, pp. 1145-1159, 1997.

[34] "Hospitalization for Heart Attack, Stroke, or Congestive Heart Failure among Persons with Diabetes", Special report: 2001 – 2003, New Mexico.

[35] Chen, J., Greiner, R., "Comparing Bayesian Network Classifiers", In Proc. of UAI-99, pp.101–108, 1999.

[36] "Heart Disease" from http://chinese-school.netfirms.com/heart-disease-causes.html

[37] Jiawei Han, Jian Pei, Yiwen Yin, Runying Mao, "Mining Frequent Patterns without Candidate Generation: A Frequent-Pattern Tree Approach", Data Mining and Knowledge Discovery, Vol: 8, No: 1, pp: 53 - 87, 2004.

[38] Kensaku Kawamoto, Caitlin A Houlihan, E Andrew Balas and David F Lobach, "Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success", BMJ, Vol. 330, No. 765, 2005.

[39] Zadeh, L.A., "Fuzzy sets", Information and control, vol.8, pp. 338-353, 1965.

[40] R. Agrawal, T. Imielinski, A., Swami, "Mining association rules between sets of items in large databases", in Proceedings of 1993 ACM SIGMOD Intl. Conf. on Management of Data, Washington, DC, pp. 207–216, 1993.

[41] UCI machine learning repository from "http://archive.ics.uci.edu/ml/datasets.html".

[42] Wen Zhu, Nancy Zeng, Ning Wang, "Sensitivity, Specificity, Accuracy, Associated Confidence Interval and ROC Analysis with Practical SAS® Implementations", NESUG proceedings: Health Care and Life Sciences, Baltimore, Maryland, 2010.

Evaluation Study of the Algerian experience in the field of employment and promotion prospects

Dr :Aichi Kamel
University of Batna – Algeria

Dr :Merazega Aissa
University of Batna – Algeria

Dr :Zitouni Ammar
University of Batna - Algeria
E-mail: aichikam05@yahoo.fr

Abstract

Through this paper, we address the dilemma faced all countries of the world without exception and even developed countries and of unemployment. And Algeria are among the countries suffering from worsening of this phenomenon, especially with the intensification of the global financial crisis, and this in spite of the efforts made in this regard. The state has allocated devices and mechanisms to absorb unemployment. The study concluded that there must be a plan and a clear and future strategy enables the absorption of unemployment, especially among young people constantly and permanently dependent on giving importance to the development of local and return to productive investments, especially in industry and in sectors of labor-intensive, especially small and medium industries and linked industries large and activating devices and mechanisms exist to absorb unemployment.

Keywords: Employment, Unemployment, Labor Market, Institutional Framework, Labor Flexibility, Dynamic Labor Market, Level Control Work.

Introduction:

Through this paper, we address the problem in all countries of the world without exception and even developed countries and of unemployment. And Algeria are among the countries suffering from worsening of this phenomenon, especially with the intensification of the global financial crisis, and this in spite of the efforts made in this regard. The state has allocated devices and mechanisms to absorb unemployment, and noted that these mechanisms do not guarantee the sustainability of providing jobs in the medium and long term. And it must develop a plan and a clear and future strategy enables the absorption of unemployment, especially among young people constantly and permanently dependent on giving importance to the development of local and return to productive investments, especially in industry and in sectors of labor-intensive, especially small and medium industries and linked industries large. To address this issue thoroughly, study adopted to analyze the reality of operating among young people in Algeria and promotion prospects in the light of global economic shifts.

And in this area pose the main question: To what extent the success of the Algerian experience in the field of youth employment and combat unemployment? Does mechanisms and policies adopted managed to alleviate unemployment in the future? With this in mind we will try to shed light on the nature of employment policy and their legal and regulatory frameworks and mechanisms operating in Algeria and the reality and the prospects for employment policy in Algeria.

1 what operating policies and their legal and regulatory frameworks: The employment policy is part of the economic development policies and social development in the country, on the grounds that he cannot concern aspects of physical without human aspects, by virtue of that the goal of development is to provide adequate decent livelihood for citizens, which comes to provide jobs and placing programs effectively to ensure newcomers to the labor market,

* Defining the operating policy:

Employment policy consists of two words: Policy: a set of administrative procedures and regulatory measures. OS: It all processes affecting human-induced physical activity or physical occupies his time for a fee. Employment policy: the method adopted by the community about the employment of the labor force available, and set up and configure their in the regulation of relations between workers and employers, through instructions and rules and laws, and reflect the policy of operating ideological economic and social system based and his work right citizen in it.

* Employment policy:

The method adopted by the community about the employment of the labor force available, and set up and configure their in the regulation of relations between workers and employers, through instructions and rules and laws, and reflect the policy of operating ideological economic and social system based and his work right citizen in it.

As you know the policy of operating on it: the policy that aims to achieve full employment and job growth consistent growth in different industries and regions

*Employment policy in Algeria: means all software or hardware that was established with the purpose integration البطالين in the labor market, through an organized activity of idle person earns a situation socially and financially under the umbrella of the following hardware and software:

- National Agency for support of youth employment ANSEJ

- A national fund for unemployment insurance CNAC

- National Program for Agricultural Development PNDA

- National Agency for the conduct of the micro loan ANGEM

- Wage employment initiative local (youth employment) ESIL

- Works program of public interest for the use of labor-intensive TUP.HIMO

- Social network program IAIG

- A program pre-employment contracts CPE

- A professional integration DAIS.

As for employment policy a clear reflection of the ideology of the dominant system, can distinguish between the two policies for operation are:
• employment policy in the framework of the capitalist economy: which focuses on the grounds the workforce commodity price is determined on the basis of the law of supply and demand in the labor market, and this is opposed to the idea of direct state intervention in the provision of employment opportunities for members of the workforce.
 • employment policy in the framework of a socialist economy: labor is the source of all values and a right of every citizen, but it is the duty of it, and the state must intervene in the provision of employment opportunities for members of the workforce who want it, while ensuring freedom of choice and stability.

This difference in perception of the work inevitably led to the difference in perception of the operation, which means the use of the labor force in one of the economic activities (production or services), while the considered in the capitalist system is just a means to achieve other goals, they are considered in the socialist system goals in itself.

If fully operational in developed countries reflects more or less ability economies to absorb the labor force available, the situation in developing countries fully reflected, and this because of the big show for labor resources, which pays often and necessities social and political to use is a product of the labor force, and despite that access to the degree fully operational is difficult to achieve, even in the case of the economy's ability to absorb all members of the workforce, the amount of unemployment will be located because there all the time transition from one job to another, and this is what is causing a number of workers unemployed, and unemployment here differ from those resulting from the failure to provide jobs, temporary unemployment being required by the nature of economic development, which is common in developed countries over the past decade in developing countries.

2- Track job in Algeria:

The Algerian economy, like other global economies, over different economic cycles since independence. During the period 1967-1986, Algeria adopted in its economic and social development schemes spotted her considerable funds, especially in the industrial sector, which led to run a large number of labor and thus absorb unemployment.

The economic crisis multidimensional experienced by Algeria since the mid-eighties, and of low oil prices have led to a global recession, and thus the lack of

investment has led to a lack of employment opportunities. The period nineties are other've known several economic and social problems particularly attached external indebtedness and debt servicing, which made Algeria resort to negotiations with the International Monetary Fund and acceptance program structural adjustment which had a negative impact on the social aspects, which resulted in a reduction in state spending in the social sectors especially in education and health. The closure of many economic institutions, and thus layoffs in large numbers had further exacerbated the dilemma operating.

The nineties period also has been marked by insecurity and acts of sabotage of economic and social facilities which increased in unemployment. This situation has led to large imbalances between employment and demand, as record mismatch between the outputs of universities and institutes of higher education and training institutes and employment opportunities, where you add Algerian universities alone more than 120 thousand students a new job every year. This is the opposite direction mentioned above, has led to major disruptions in the balance of the labor market.

The application of the structural adjustment program, has led to major balances in the Algerian economy since the beginning of the third millennium, which was supposed to lead to the resumption of growth by investing in all branches of economic activity, especially those for intensive use of labor as branches of industrial activity. But the reality gave opposite results, any weak growth rates due to poor investment that led to reduced employment opportunities.

3 - The economic situation during the third millennium and the labor problem in Algeria

We have improved the performance of the Algerian economy in recent years, with the growth rate of 3 percent in 2009 versus 02 percent in 2008, as record continuous improvement at the level of macroeconomic balances, whether regarding the status of the balance of payments or surplus at the level of the trade balance and the like that at the level of the state budget, as well to this remarkable stability in the exchange rate and low inflation. This is due to the economic reforms undertaken by Algeria since the nineties of the last century, whether subjective or reforms supported by the Global Fund and the World Bank.

Where the Algerian government had several structural reforms in order to transition to a market economy, which reflected positively on the balance a range of economic indicators and the liberalization of the economy. Add to this rise in fuel revenues and therefore government investment, which led to the recovery of non-oil sectors such as housing, public works and public services sector, transport and trade.

This is what was done by the State through the economic recovery program 2000-2004, as well as program support economic growth 2005-2009, who devoted two sums. Now the Algeria embarked on an ambitious development program during 2010 - 2014, which has been allocated a sum of money estimated at 286 billion dollars.In the sense that the current situation is characterized by:

- A stable macroeconomic framework and appropriate.

- Register a return to growth outside the hydrocarbon sector

- Exchange reserves is important.

- Uncontrolled inflation.

- Important programs for public and private investment.

- The return of security and stability.

However, it is noted that in spite of this economic recovery at the macroeconomic variables, we note the continuing phenomenon of unemployment in the Algerian economy, especially among young people, where there is an imbalance in the labor market between supply and demand sides.And Level Algeria there is an imbalance between the supply and demand sides as follows:

1) Variation in the geographical distribution of the labor force.

2) the unbalanced distribution of the labor force on the various activities where the labor force is concentrated in agriculture, wholesale and retail trade and some parasitic activities of a quick profit.

3) Lack of balance between the outputs of education and training and labor market needs.

4) The inability of the Algerian economy to provide jobs for the workforce, especially with abandon on investment in the industry, and increase the unemployment rate in the different regions of the nation.

We note in this regard that the government has a set of procedures and exceptional measures to alleviate unemployment and its negative repercussions especially among the youth and was such procedures in the development of many programs to upgrade labor and the creation of specialized structures for its implementation with a focus on a broad campaign to raise awareness and guidance for the success of these programs, has helped the return of calm and security and stability to the entire national territory on the one hand, and on the other hand recruiting potential significant financial, either through direct state investment through its designated for that purpose or the contribution of private investment by national and foreign.

In this, we see that the state and put strong and specialized structures able to withstand the magnitude of the tasks entrusted to it, and we mention in this regard:

• National Agency for Employment.

• National Agency for support of youth employment

• National Agency for the conduct of the micro loan.

• National Fund for unemployment insurance.

• Directorate state to run.

• Social Development Agency.

• As has been the establishment of the National Observatory of the operation and the fight against poverty.

And centered goals of these agencies various structures on easing the pressure on the labor market through the application procedures and job upgrading programs funded by the state, which is considered one of the pillars of success of the efforts to combat unemployment and promote professional integration.

Through the above noted that there is considerable efforts undertaken by the agencies and structures allocated to upgrade the job, but actually refers to the continuing imbalance in the labor market and increased demand for labor continued in spite of a statement on the authorities to reduce the unemployment rate to less than 10 percent. The reason not to reduce unemployment to a reasonable level to:

• reduce investment in sectors and labor-intensive activities, especially small and medium industries and reduce the industrial fabric.

• heavy investment in sectors related to infrastructure in order to create the right atmosphere to attract national and foreign investments, especially in the field of roads and connectors, power plants, dams, railways and create industrial zones that do not use hand labor-intensive and expensive to create jobs where high.

• The private sector to invest in activities that are not running labor-intensive to escape high wages, especially if these activities do not generate a quick profit.

• The abolition of the state monopoly of foreign trade law in the framework of the agreement with the International Monetary Fund has led to the transformation of a lot of properties to importers of goods were mostly they producers, resulting in layoffs and thus contribute to the increase in the unemployment rate.

• Increase in population, where Algeria achieved the highest rates in the world during the seventies and eighties of the last century, which led to a rise exceeded the proportion of young people more than 65 percent and who are in the request to act is now.

• Weighting in business (which does not create many jobs).

• Incompatibility between the outputs of the university and training institutes and operating requirements, where Algeria is available on a significant number n estimated 120,000 university degree holder coming year on the labor market.

• Difficulty in obtaining bank loans especially for young entrepreneurs.

• Lack of a national network to collect information about operating, making a huge number of workers due to the inclusion of temporary contracts and pre-operating places permanent as well as the statistics provided by the National Agency for Investment Promotion about creating places the job depends on the submission of a party residing projects in many These projects often do not last or do not employ labor theater according to preliminary estimates.

• The situational mechanisms adopted by the State in order to alleviate unemployment, can not contribute effectively in private absorbed in the medium term and long term. It is also during the application on the ground, there were some shortcomings, including what is common and what is specific to each device. For these reasons, we note worsening problem of unemployment in Algeria, especially in the state of Batna in spite of possibilities available to them in the field of labor,

4 - Possibilities in Algeria to promote youth employment and absorb unemployment:

In this context, implementation of the new strategy, record interest in the Algerian authorities and the local private American homeland to fight unemployment and promotion of employment because of suffering in this regard despite the possibilities that are available various Almntaq and as yet untapped to absorb unemployment.

Algeria is available on a lot of resources that have not yet exploited, whether in the field of agriculture, where it enjoys cultivating desert and mountainous and plain and pastoral as well as the possibilities of raising poultry, cattle and bees and the establishment of manufacturing industries linked product, local Masir olive juice and puree apples, apricots, etc.

The different states of Algeria is rich in tourist areas and the effects that can be exploited by creating activities and tourist facilities contribute to the creation of a dynamic economic and create a large number of jobs for the youth of the region, given that the creation of jobs and one in tourism will lead to a more than five jobs in other sectors that will work tourism recovery.

And also the development of traditional industries and crafts that feature these areas that will contribute to the development as many traditional industries.

Add to that site's strategic advantage by Algeria as located on the Mediterranean and in the crossroads between the north and south and the high plateaus, this would work to find industrial areas can be developed and configured especially with the construction of a road highway east - west and through the high plateaus will contribute to the service industry in these areas attract local and foreign investors and to devote the culture of industrial investment by providing facilities management, real estate and provide the investment climate in these regions, which can be converted in the future to free zones, and thus contribute to the absorption of unemployment in all the states.

5 - the most important deficiencies related to the devices:

5 – 1: shortages grave in the quantity and quality framing device on a different level, leading to the length of the study files.

5 – 2: along the administrative procedures and complexity of the large number of stakeholders in the process (the National Insurance Fund earners CNAS and the insurance fund for salaried CASNOS and the National Center for Trade Register CNRC and room taxes and peasant ...).

5 -3: complicate procedures for obtaining bank loan and lack of commitment banks agreements concluded with regard to deadlines study selected files two months (02) However, due to the lack of supervision often outweigh the duration full year, and as a result of this situation, we find, for example, that the National Agency for the support and operation of youth ANSEJ had deposited with the banks until 31/12/2010: 8514 file certified by the party committee rehabilitation, but we find that the 2841 draft only get bank approval, although it represented in the committee rehabilitation. It also requests additional collateral especially if the loan is related to agricultural activity, such as property and mortgage contracts.

5 – 4: problem agricultural property, given that most of the territory of the state, the territory of the throne which hinder the process of getting loans.

5 -5: general trend toward youth activities and transport equipment rental, which is considered non-generating activities to fill the positions.

5 -6 : the lack of areas of economic activity and industrial zones equipped and motivated to bring investment in productive activities. And that existing ones remained of it except the name only, as it turned on its original functions, and became within the urban fabric and pose a threat to the ocean, as well as the owners have turned part of it to the stores and accommodation.

5 -7: the inability of institutions miniature adult competition from contractors to get the deals.

5 -8: lack of funding in some programs, especially those run by the National Agency for the conduct of loan mini ANGEM, where we find that the loans acquisition of raw materials does not exceed 30 thousand dinars and private loans

acquisition gear does not exceed 400 thousand dinars, and that the burden on the device, and borne by the student loan often than 70 thousand dinars.

In addition to shortcoming of these devices, the procedures and mechanisms former is real does not guarantee the continuing permanent in providing jobs, and therefore radical solution to this dilemma lies in the return to the heavy investment in sectors and activities that ensure the provision of jobs, such as the industrial, private branch small and medium-sized enterprises. This is why we recommend a new strategy for the job, which managed to ensure continuity in the provision of jobs.

6- New strategy for the job:

In order to alleviate unemployment, we find that things are heading now to market local operating by the authorities to upgrade operating at the local level, where the hotfix mechanisms work of agencies operating to eliminate unemployment in Algeria states expand the powers of intervention the state in the field of operating to become the state center real proposal to ensure synergy between national programs and local initiatives in the field of employment. We note in this regard that the reports on employment showed weak contribution of local communities in the mechanisms of the elimination of unemployment. Accordingly, the new strategy to upgrade the operating and fighting unemployment depended on axis supporting the development of local initiatives to run a important hub recommended by ILO experts and applied in many successful experiences in the field of operating upgrade. And must include this strategy include:

6-1: In parallel with the completion of the highway east - west and by high plateaus and railway, should be given the powers to local authorities to establish and create areas of activity and industrial areas outside the urban context can be termed areas industrial "key in hand" be equipped with all the necessities, such as provision of water, electricity and gasthe phone and the various means of communication and warehouse purposes and in order to motivate and attract investors and avoid wasting time and effort between various departments, where the effort remains the investor is only bringing in the means of production and installation. This type of industrial areas will inevitably lead to increasing the number of private investors in small and medium-sized enterprises and small and medium industries, which included the largest number of jobs.

These institutions also can contribute to import substitution and thus reducing dependence on the one hand and to provide financial resources in hard currency on the other hand, which can be used in other areas The presence of such areas will stimulate undoubtedly attract parallel economy to enter into a real development, and thus contributing to absorb unemployment.

6 -2 : In order to exploit all the economic establishments and commercial public unexploited state, and because of the specificity of jurisdiction where the significant shortage of container estate on the one hand and lack of employment opportunities in the economic sector on the other hand, we propose to grant to local authorities extraordinary powers to dispose of and restarted ways appropriate to be able to contribute to the absorption of part of the unemployment.

• In addition, generally must support investment in the economic sector generator of jobs, through:

- The implementation of industrial strategy.

- Guiding the implementation of all plans for the development of various sectors.

- Support the development of small and medium-sized enterprises

- Accelerate the reform of the pattern of organization of public agricultural land and exploitation.

- Accelerate the reform of industrial property.

• upgrade policy of stimulating the creation of jobs towards institutions through:

- Improve the level of incentives applicable in the tax field and semi Aljba I In the area of investment promotion.

- Support the development of entrepreneurship.

• Encourage projects related to local development.

• The contribution of the banking sector in the success of the strategy pertaining to the promotion of employment through:

- Specialization in the mini-enterprise and open windows especially at the level of banks and the decentralization of bank loan at the level of the state branches of the banks.

- The integration of bankers at the branch level state in a local development to see the development projects in the region and this in the presence of the sessions of the Council local to the development of the region, and subject to the authority of development in the state makers.

• In general remains refer to the promotion of investments in the industrial sector and intensify industrial fabric based operating upgrade and absorb unemployment in the region.

7-The reality and the prospects for employment policy in Algeria:
Has been problematic operating inherent Lgel world economies, especially the developing ones, as a result of inadequate economic activities to absorb category active continuously growing. Also difficult for such countries to predict the future is optimistic for reducing the size of unemployment, so that the stabilization programs and structural reform as well as the management of strict debt public internal and external does not allow an adequate manner to revive investment and operating at the same time, under the dictates of institutions Of international financial conditions to correct the structural imbalances in these countries, first and foremost get rid of excess labor resulting from excessive social policy to the pre-reform period.

7-1:The reality of the employment policy in Algeria:
The case of Algeria does not differ in terms of operating problem and a sharp increase in unemployment for other developing countries, in the framework of the embodiment and the implementation of the employment policy, particularly in the area of youth employment, is facing many challenges and obstacles, among them:

• unregulated work, which is the inevitable alternative for many young people coming into the labor market, in front of weakness, but the scarcity of employment opportunities in the regulated institutions. This kind of work is hotbeds exploitation of many young people, which is usually the most vulnerable to this exploitation, whether in the area of working conditions, or in wages, or the various individual and collective rights of the worker, in the absence or weakness of regulatory bodies, on the one hand. With the expansion in the application of the

idea of flexible work, temporary work, on the other hand. Rising practice of fixed-term contracts in Algeria and continues to rise until now, especially in front of the lack of control, sometimes and sometimes weakness.

• lack of control over the legal mechanisms and the social and economic state began in installed in order to tackle unemployment, especially those charged with organizing and framing the labor market, which lacks the means of statistical evaluation and measurement enough about the fact that unemployment among young people. Along with lack of harmony and consistency between devices based on the fight against unemployment and employment, which impedes the success of numerous experiments and considered that efforts have been undertaken to reduce the growing severity of this phenomenon.

• Do not adjust systems and programs of higher education and training and in proportion to the average needs required by the labor market, which means more tire configuration and workers who will not find jobs suited composition, making them vulnerable to the inevitable unemployment when they graduate. Due to lack of coordination and cooperation between these offices and institutions aimed at providing jobs for the slides unemployment, on the one hand and training institutions upper and middle, specialized and public, on the other hand, institutions used a third party, where there is most of these countries on the boards of joint coordination between all these institutions to work to ensure the effectiveness of the financial and administrative efforts to ensure the provision of jobs for each graduating from colleges and universities and vocational training institutions. Though they found no lead role required efficiency.

In the face of all these challenges and constraints often negative hindered the success of employment policies, highlight a group mechanisms, programs and plans developed by the country's challenge positively to face the negative effects, where you play small and medium enterprises, for example, one of the mechanisms to meet these challenges: Due to the fragility of the economic structure that began known fabricin recent years, economic, as a result of the trend towards liberal economy, on the one hand. As a result subversive acts that affected the country in the nineties, as there are no industrial enterprises large integrated as it exists in the major industrialized countries, as it became to resort to small and medium enterprises specializing in various fields craftsmanship, and service, especially those working in the field of entrepreneurship secondary for major industrial enterprises or branches in Algeria, one of the least expensive solutions to achieve economic integration, on the one hand. One means by which included alleviating the growing unemployment in these countries, especially among young people graduate from universities and specialized training institutes.

7-2:Prospects of activating and success of employment policies in Algeria:
Among the factors that help to success and raise the effectiveness of employment policy, a combination of factors can be summarized as follows:

1. For public policy of the run: controls the success of these policies are several considerations and factors that could remind them:

Need to build this policy studies and real data with the participation of relevant bodies and organizations the world of work, in various levels and relevant institutions, with the need to take into account the views and suggestions of these

bodies and institutions as much as possible. And stay away as possible from the arbitrary decisions that are not based on such studies.

- Continuity in the implementation of the policies, and not change for change, before evaluating the efficacy or not.

- work to adapt and modify themes and elements of this policy to suit the developments posed by internal and external variables, and constraints field, and making them more flexible and adaptable to developments and changes required by the practice, where it is often characterized by the decisions taken at the level of central departments character commands that do not taken into account when making field obstacles.

2.For patterns operating: Must be characterized by these patterns and shapes in nature permanence and continuity, and to avoid as much as possible for patterns operating fragile that do not address the problem of unemployment permanently, to the extent that mere palliatives temporary not soon lose their effect over time, which raises problems of unemployment again.

Must also ensure that the application of legal and regulatory measures concerning the implementation of employment policies through these patterns form in which they are capable of achieving the goals set them, and put practical mechanisms to assess progress in applying these measures, and assessment of obstacles and problems faced by the application, in order to correct its course continuously.

Conclusion:

As already mentioned, the programs and structures established by the State in the field of integration and operating many and varied and important but remains its success is linked to significantly the effectiveness of the role of guidance and information and bring every student work device driver that fit in., and if that falls within the traditional tasks of the National Agency for operation as the body was public charged with organizing and monitoring the job market as well as the departments operating States as representing the authority of the Minister of Employment at the local level, what can be said for Algeria is that the role of guidance and counseling in operating not confined specifically in the activity of the board of certain there are no sections dedicated to this matter.

Recommendations and suggestions:

After all that saved us findings from this study, which summarized the policies operating in Algeria, and after addressing the most important problems that you know these policies, we must make some recommendations to the relevant authorities and decision-makers see meaningful for a good application of these policies to reduce unemployment.

* Must be an agreement between the institutions that receive the beneficiary and operational mechanisms to ensure receiving all their rights.

* Reconsider the programs intended to run a temporary and symbolic amounts.

* Resurrect the relationship in the labor market and productivity institutions to enable students to get part application allows them to blend, especially if we know that the professional experience plays an important role.

*   Do regular and continuous investigations by the Ministry of Labor on the application of these mechanisms in the field.

*   Abandoning the idea of static disciplines, and make specialties dynamic flexible keep their market requirements.

Bibliography:

Huber G.P. 1990, « Atheory of the effects of advanced information technologies on organizational design, intelligence and decision making », The Academy of Management Review, n° 1, Janvier. 1990, cité par R. Reix.

Ghomari. A-R. 2008, Approche méthodologique d'acquisition de connaissances agrégées à base d'agents cognitifs coopérants pour les système d'aide à la décision stratégiques, Thèse de doctorat, INI, Algérie.

Grouard B., Meston F. 1995, L'entreprise en mouvement : conduire et réussir le changement, Dunod, Paris.

www.ons.dz

WWW.ANGEM.DZ.

www.ANSEJ.DZ

Chérif Chakib Anouar et Tchouar Kheir-Eddine, . « chômage et politique de l'emploi en Algérie » , colloque de l'université de Tlemcen, les politiques économiques : réalités et perspectives , nov 2004

FEMISE 2005, Profil Algérie, Institut de la méditerranée, janvier 2006

Reveu conjoncture, N° 22, Algérie, Décembre 1995,

Bianchi, Miller and Bertini, 1997 '' The Italian SME Experience and Possible Lessons for Emerging Countries'', UNIDO, March,**.**

Annane,S.(2004) L'emploi et l'insertion en Algérie ,Actes du colloque internationale sur la question de L'emploi en Afrique du Nord organisé par le CREAD , 26-28 juin , Alger,

Kpodar ,K (2007) Why has Unemployement in Algeria Been higher than in MENA and transition Countries ?IMF Working paper , African Department.

Students' Perceptions of Learning Strategies in French and Japanese Language: A Quantitative Approach

Dr Hazlina Abdul Halim

Faculty of Modern Language and Communication
Universiti Putra Malaysia
603-89468752, nina@fbmk.upm.edu.my

Dr Roslina Mamat

Faculty of Modern Language and Communication
Universiti Putra Malaysia
603-89468666, roslina@fbmk.upm.edu.my

Dr Normaliza Abdul Rahim

Faculty of Modern Language and Communication
Universiti Putra Malaysia
603-89468766, normaliza@fbmk.upm.edu.my

Abstract

Learning strategies are one of multiply factors on achieving learners' target on acquiring a foreign language. Thus, this exploratory study aims to analyse Malaysian students' perception of the types of learning strategies employed in learning French and Japanese as a foreign language. The respondents for this research were 100 students of French and Japanese language. The study utilized quantitative method of data collection by applying the Strategy Inventory for Language Learning (SILL) as an instrument to investigate the frequency of language learning strategy used by learners of both languages. The study aimed to find the similarity and the differences of strategies used in French and Japanese. The results showed that the students of Japanese and French were perceived to frequently use cognitive and metacognitive strategies and the strategies least used by the learners were affective and memory strategies. This study has implications for foreign language learners and instructors to address the strategies used by learners in learning a third language. The result of the study showed that language instructors have to consider the existence of language learning strategies in all learners and which strategies they used the most.

Keywords: Quantitative, Learning Strategy, French Language, Japanese Language

Introduction

One of the objectives of learning a new language is for the learners to be able to transfer their thoughts in that particular language verbally and and in written form. According to Ainol Madziah Zubairi & Isarji Hj Sarudin (2009), for a person to be able to partcipate in global economy, one has to be equipped with the competence, the knowlege, skills and the correct behavior to understand and communicate effectively. Hence, learning a foreign language effectively means using adequate learning strategies (Meschyan & Hernandez, 2002). Cook (2001) indicated that language learners are known to use various strategies when they start learning the second or foreign language. These strategies have deep impact on learners' approach on the new language and how successful they are in acquiring the language skills. Cook (2001) further indicated that by gaining more information on how the learners actually learn a language can help to make any teaching method more effective. As Wenden (1985) reminded us, "If you give a man a fish, then he eats for a day. But if you teach him how to fish, then he eats for a lifetime".

For Rigney (1978), learning strategies are procedures which facilitate acquisition, retention, retrieval and performance. Oxford (1990:8) expanded this definition and defined the term as "specific actions taken by the learner to make learning easier, faster, more enjoyable, more self-directed, more effective, and more transferable to new situations". Macaro (2003:327) added that "strategies must contain not only an action but also a goal and a learning situation". Chamot and Kupper (1989) indicated that all language learners use a certain type of language strategies but there are difference in the type of frequency and the choice of use among different learners. The choice of strategies used is influenced by many factors, as such motivation, sex, age, self-perception of proficiency, duration of learning the language, attitude, language learning goals, personality, national origin, teaching methods and strategy training (Chamot, 1993; Oxford, 1989; Oxford & Crookall, 1989; Oxford & Ehrman, 1995).

Oxford (1990:9) views the objective of language learning strategies as leading to the development of communicative competence and divides language learning strategies into direct and indirect strategies, which are further subdivided into 6 groups. In Oxford's (1990) definition, metacognitive strategies help learners to regulate their learning; affective strategies are strategies which are connected to learner's emotional requirements, while social strategies focus to stimulate interaction with the target language. The three other strategies which are cognitive strategies, memory strategies and compensation strategies also have their own functions. Cognitive strategies are the mental strategies used to make sense of the language learnt, memory strategies are for storage of information (Hismanoglu, 2000).

Compensation strategies on the other hand, allow the learners to guess the meanings of the unfamiliar words they encounter (Yang, 2007). Shamis (2002) indicated that compensation strategies help to overcome knowledge breach to enable the learners to continue the communication by switching to another language they know (for example their mother tongue or second language), using clues, getting help and using a synonym to express themselves.

This six subdivision of Oxford leaning strategies, known as Strategy Inventory for Language Learning (SILL) was used in this research as a tool in determining the strategies used by learners of French and Japanese in learning the language.

The French and Japanese language, though are linguistically different (Hazlina *et al.,* 2009a) from most of the utilized languages in Malaysia, namely Malay, English, Chinese and Tamil, are among the most popular foreign languages learnt in Malaysia. Among the striking differences are the grammar, character and pronunciation. These differences present the difficulties to the Malaysian students learning French and Japanese as a foreign language, both in the writing and speaking skills.

In order to help these students acquire the competence in these two languages, various strategies are used, which are learning and communicative strategies. Hence, the objectives of this research were to list down the types of strategies perceived by Malaysian non-native speakers of French and Japanese as a foreign language and to investigate the strategies they used the most and the least. The study also aimed to find the similarity and the differences of strategies used in French and Japanese learning.

Materials and methods

This exploratory study utilized quantitative method of data collection. The subjects consisted of 2nd and 3rd year foreign language students from different fields of humanities, social and sciences in Universiti Putra Malaysia, with the age range of 20 to 24. A total of 100 subjects (n=50 for Japanese and French students) participated in this study, 29 males and 71 females.

The instrument used in the study were a 2 part questionnaires consisting of 56 items, first 6 items were for the subjects' demography and the next 50 were to investigate the perceived learning strategies using the Likert scale (Scale 1 being the most frequently used and 5 never to be used). The study applied the Strategy Inventory for Language Learning (SILL) by Oxford (1990) as an instrument to investigate the frequency of language learning strategy used by learners of both languages.

Results and Discussion

Overall result of learning strategies used by French and Japanese learners

Oxford (1990:291) indicated that a mean of all subjects using Likert scale in the range of $3.5 - 5.0$ as high use of the strategy, the range of $2.5 - 3.4$ as moderate use and the range below 2.4 is regarded as infrequent use.

The overall SILL mean in this study was 3.56, with a standard deviation of 0.9354, which means that the learners highly used the learning strategies in their study. This finding is in line with most studies conducted (Green & Oxford, 1995; Oh, 1992), where learners tend to report high frequency of strategy use on the SILL (mean =/3.5).

Table 1 shows the mean strategy use for each of the six categories of SILL. The result indicated that affective strategies (M=3.44) and affective strategies (M=3.232) were moderately utilised by the students in their French and Japanese learning, while the other four categories were used extensively (M>3.5).

Table 1: List of mean according to SILL categories

SILL category	Mean	*sd*
Memory strategies	3.4400	.9287
Cognitive strategies	3.6936	1.0578
Compensation strategies	3.5767	.8332

Metacognitive strategies	3.7644	.8697
Affective strategies	3.2320	1.0125
Social strategies	3.6800	.9107

This result supports the findings obtained by Wharton (2000), where the affective strategy category was also found to be moderately used. Zooming deeper into the categories, it is found that these strategies were used extensively by the learners:

Table 2: List of strategies frequently used by the learners

Strategy	Detail of the strategies	Average	sd
Cognitive 1	I say or write new words in the target language several times.	4.21	.7534
Cognitive 13	I try not to translate word-for word	3.99	.8468
Compensation 1	To understand unfamiliar words in the target language, I make guesses.	3.92	.8490
Metacognitive 3	I pay attention when someone is speaking the target language.	4.13	.7338
Metacognitive 4	I try to find out how to be a better learner of the target language.	4.08	.7478
Social 2	I ask the native speakers to correct me when I talk.	4.08	.7203

Six learning strategies were found to be most frequently used by the learners, as shown in the Table 2 above. The strategies involved were cognitive strategies (2), compensation strategies (1) metacognitive strategies (2) and social strategy (1). For cognitive strategies, item 1 ("I say or write new words in the target language several times") and item 13 ("I try not to translate word-for word") were the strategies frequently used by the learners, with the mean of 4.21 (sd=0.7534) and 3.99 (sd=0.8468) respectively.

From Table 3 below, it is found that for Item 1 under cognitive strategy, the mean for female learners (M = 4.3662, sd = 0.80485) were higher by almost 0.5 points compared to the male learners (M = 3.8276, sd = 0.73460). Item 13, however showed an almost equal mean between the two genders.

For metacognitive strategies, the two strategies with frequent use among the learners were Item 3 ("I pay attention when someone is speaking the target language") with the mean of 4.13 and Item 4 ("I try to find out how to be a better learner of the target language") with the mean of 4.08.

Table 3: Cognitive strategies frequently used by the learners

		N	Mean	sd	Min	Max
Cognitive 1	Male	29	3.8276	0.80485		5
	Female	71	4.3662	0.73460		5
	Total	100	4.21	0.75338		5
Cognitive 13	Male	29	3.9655	1.0516	2	4
	Female	71	4.0000	0.7559		5
	Total	100	3.9900	0.8468	1	5

It is observed from Table 4 that for both metacognitive strategies Item 3, the mean for male learners (M=4.2759) were slightly higher that for the female (4.0704). For item 4, however the mean for both genders were almost equal (4.1379 for male and 4.0563 for female).

Table 4: Metacognitive strategies frequently used by the learners

		N	Mean	*sd*	Min	Max
Metacognitive 3	Male	29	4.2759	0.75103	2	5
	Female	71	4.0704	0.72356	3	5
	Total	100	4.13	0.73382	2	5
Metacognitive 4	Male	29	4.1379	0.83342	3	5
	Female	71	4.0563	0.71489	2	5
	Total	100	4.08	0.74779	2	5

This result was similar to social strategy Item 2 and compensation strategy item 1, as shown in Table 5 below:

Table 5: Social and compensation strategies frequently used by the learners

		N	Mean	sd	Min	Max
Social 2	Male	29	4.2414	.78627	1	5
	Female	71	4.0141	.68646	1	5
	Total	100	4.0800	.72027	1	5
Compensation 1	Male	29	4.1379	.87522	2	5
	Female	71	4.0563	.84325	1	5
	Total	100	4.0800	.84900	1	5

Table 6 below shows the list of learning strategies least used by the learners. The strategies were memory strategies (Item 6 and 7), compensation strategy (item 4) and affective strategies (item 3 and 5). Affective strategy item 5 was the least used learning strategy by the learners, with the mean of 2.26 and standard deviation of 1.1426. This was followed by memory strategy item 6 with the mean of 2.46 and the standard deviation 1.0864. Lee & Oxford (2008) explained the reason memory strategies were not frequently used by Asian learners as opposed to other strategies is that the items for memory strategy in the SILL are focused on vocabulary, without inclusion of rote memory and repetition, which contributes to the successful memorization of Asian learners.

Table 6: List of strategies least used by the learners

Strategy	Detail of the strategies	Average	sd
Memory 6	I use flashcards to remember new words in the target language.	2.46	1.0864
Memory 7	I physically act out new words in the target language	3.04	.9632
Compensation 4	I read in the target language without looking up every new word.	3.06	.7762
Affective 3	I give myself a reward or treat when I do well in the target language.	3.02	1.0916
Affective 5	I write down my feelings in a language learning diary	2.26	1.1426

Zooming towards the use of the strategies by different genders, it was observed that for affective strategy item 3, there was a significant difference between the male and female learners as shown in Table 7 below:

Table 7: Affective strategy Item 3 used by the learners

		N	Mean	sd	Min	Max
Affective 3	Male	29	2.6897	1.00369	1	5
	Female	71	3.1549	1.10386	1	5
	Total	100	3.0200	1.09157	1	5

It is observed from the table that male learners used SILL affective strategy item 3 ("I give myself a reward or treat when I do well in the target language") less frequently than the female learners (mean = 2.6897 for male and 3.1549 for female), with the difference of 0.53 point.

Comparison of learning strategies between French and Japanese learners
The result of the study showed that overall, French and Japanese learners highly utilized the learning strategies with the mean of 3.5008 (*sd*=0.8745) for French and 3.5292 (*sd*=0.8839) for Japanese.

Table 8: List of mean according to SILL categories for French and Japanese learners

	French learners		Japanese learners	
	Mean	**sd**	**Mean**	**sd**
Memory strategies	3.3600	.9028	3.5200	.9354
Cognitive strategies	3.6529	.9052	3.6914	.8732
Compensation strategies	3.5867	.8106	3.5667	.8542
Metacognitive strategies	3.8200	.8607	3.7089	.8782
Affective strategies	3.2000	.9838	3.2640	1.0324
Social strategies	3.6267	.8999	3.6667	.8935

Table 8 shows the repartition of the SILL frequency for Japanese and French. The result indicated that cognitive strategies, compensation strategies, metacognitive strategies and social strategies were used extensively by learners of both languages (M> 3.5). On the other hand, for affective strategies, learners of both languages used the strategies moderately. This could be seen from the mean of 3.2000 for French (*sd* = 0.9838) and 3.2640 for Japanese (*sd* = 1.0324). The result for memory strategies however differs for French and Japanese where it was found that French learners moderately used the strategies (M = 3.3600), whereas Japanese learners highly used the same strategy (M = 3.5200). Zooming towards the strategies frequently used by the Japanese and French learners, the following result was obtained:

Table 9: List of strategies frequently used by the learners of French and Japanese

		French learners		Japanese learners	
		Mean	**sd**	**Mean**	**sd**
Cognitive 1	I say or write new words in the targeted language several times.	3.7600	.71600	4.0600	.76692
Cognitive 10	I look for similar words in my own language	3.6000	1.10657	3.9800	.58867
Cognitive 13	I try not to translate word-for word.	4.2400	.77090	3.7400	.85261
Compensation 1	To understand unfamiliar words in the targeted language, I make guesses.	4.0000	.78246	3.8400	.91160
Compensation 2	When I can't think of a word during a conversation in the targeted language, I use gestures.	3.9400	.91272	3.7800	.91003
Metacognitive 3	I pay attention when someone is speaking in the targeted language.	4.1800	.77433	4.0800	.69517
Metacognitive 4	I try to find out how to be a better learner of the targeted language.	4.1200	.79898	4.0400	.69869
Social 2	I ask native speakers to correct me when I talk.	4.0400	.78142	4.1200	.65900

It is found for French learners, the most utilized SILL was cognitive strategy item 13 ("I try not to translate word for word") with the mean of 4.24 and standard deviation of 0.7709. This was followed by metacognitive strategies item 3 ("I pay attention when someone is speaking in the targeted language") with the mean of 4.1800 (*sd* =0.7743) and item 4 (I try to find out how to be a better learner of the targeted language") with the mean of 4.1200 (*sd*=0.7989). The metacognitive strategy item 3 also was most utilized by the learners of Japanese with the mean of 4.0800 (*sd* = 0.6987), beside the social strategy item 2 ("I ask native speakers to correct me when I talk") with the mean of 4.1200 (*sd* = 0.6590) and cognitive strategy item 1 ("I say or write new words in the targeted language several times") with the mean of 4.06 (*sd* = 0.7669).

The frequently usage of cognitive strategy item 13 by the French learners was not surprising as Hazlina Abdul Halim *et al*. (2008b) found that literal translation was indeed the most utilized communication strategy by the learners of French. The same goes for the use of cognitive strategy item 1 by the learners of Japanese which could be explained by the need to constantly practice on the characters as this language does not use alphabets as French does.

Table 10 showed the SILL which were of infrequent use by learners of Japanese and French. From the table, it is observed that the least use SILL for learners of French were affective strategy item 5 "I write down my feelings in a language learning diary" with the mean of 2.0800 (*sd* = 1.0659). This result was equally shared by the learners of Japanese (M = 2.44, *sd* = 1.1979). Memory strategy item 6 was also shared the same result for both language learners, with the mean of 2.34 for French and 2.58 for Japanese.

Table 10: List of strategies least used by the learners of French and Japanese

		French learners		Japanese learners	
		Mean	sd	Mean	sd
Memory 6	I use flashcards to remember new words in the targeted language.	2.3400	.96065	2.5800	1.19676
Memory 7	I physically act out new words in the targeted language.	3.0200	.99980	3.0600	.93481
Memory 9	I remember new words or phrases in the targeted language by remembering their location on the page, on the board, or on a street sign.	3.3200	.97813	3.3400	1.25536
Cognitive 5	I start conversations in the targeted language.	3.4200	.97080	3.4000	.98974
Cognitive 8	I write notes, messages, letters, or reports by dividing it into parts that I understand.	3.2800	1.10730	3.3600	1.12050
Compensation 3	I make up new words if I do not know the right ones in the targeted language.	3.2800	.70102	3.4000	.98974
Compensation 4	I read in the targeted language without looking up every new word.	3.0800	.77828	3.0400	.78142
Affective 3	I give myself a reward or treat when I do well in the targeted language.	2.9000	.99488	3.1400	1.17820
Affective 4	I notice if I am tense or nervous when I am studying or using the targeted language.	3.3200	1.05830	3.3400	1.11776
Affective 5	I write down my feelings in a language learning diary.	2.0800	1.06599	2.4400	1.19796
Social 1	If I do not understand something in the targeted language, I ask the other person to slow down or say it again.	3.2000	.96890	3.4600	1.14660

This study also found the differences on the use of strategies for French and Japanese. Table 11 above showed that memory strategies item 3 and 5, cognitive strategy item 6 and compensation strategy item 5, it is found that compared to Japanese learners who highly utilized these strategies, French learners were found to use the strategies moderately. For cognitive strategy item 6, one of the factors which could explain the

extensive use of the strategy for the learners of Japanese is that there were abundance of Japanese shows and movies that the learners could watch as compared to French which could scarcely be watched. The biggest difference was found for memory strategy item 3 which showed the modest mean for French (M = 3.3800, sd = 0.8545) as compared to Japanese (M = 4.0200, sd = 0.8449).

Table 11: List of strategies used by the learners of French and Japanese

		French learners		Japanese learners	
		Mean	sd	Mean	sd
Memory 3	I connect the sound of a new word in the targeted language and an image or picture of the word to help me remember the word.	3.3800	.85452	4.0200	.84491
Memory 5	I use rhymes to remember new words in the targeted language.	3.4600	1.11043	3.6800	.95704
Cognitive 6	I watch TV shows spoken in the targeted language or go to movies spoken in the targeted language.	3.3200	1.03884	3.7000	1.05463
Compensation 5	I try to guess what the other person will say next in the targeted language.	3.3800	.92339	3.5400	.86213
Metacognitive 1	I try to find as many ways as I can to use the language I learn.	3.6800	.89077	3.4200	.90554
Metacognitive 6	I look for people I can talk to in the targeted language.	3.7600	1.07968	3.4800	1.03490

This quantitative study surveyed the foreign language learning strategies perceived to be used by Malaysians learners of French and Japanese as a foreign proficiency. Oxford's (1990) SILL (Strategy Inventory for Language Learning) was used as research instrument. The study revealed that Malaysian learners in general highly used the learning strategies (mean = 3.56).

According to category analysis, learners used six dimensions of language learning strategies: cognitive, social, association, compensation, assistance and constructive strategies. The highest among the six dimensions was metacognitive and cognitive strategies, with a mean of 3.7644 and 3.6936 respectively. According to the findings, affective strategy item 5 was the least used by the learners (M = 2.26, sd = 1.1426), followed by memory strategy item 6 (M = 2.46, sd = 1.0864).

Zooming deeper into both languages, it was found that though the average utilization of other strategies were nearly similar, hence memory strategies were perceived to be less utilized by the French learners (M = 3.36) as compared to Japanese learners (M = 3.56). This supported the findings by Roswati Abdul Rashid *et al.* (2007), who found that students frequently used memory strategies in Japanese learning to recall back the Hiragana characters that were given by their lecturers.

Overall, the students of Japanese and French were perceived to frequently use cognitive and metacognitive strategies. The strategies least used by the learners were affective and memory strategies. This supported Williams et al. (2002) findings who found that students perceived to highly use cognitive and metacognitive strategies. Their findings also indicated although there were indications of reasonably high cognitive and metacognitive awareness, there was little evidence that the respondents actually used metacognitive strategies.

Conclusion

This study has implications for foreign language learners and instructors to address the strategies used by learners in learning a third language. The result of the study showed that language instructors have to consider the existence of language learning strategies

in all learners and which strategies they used the most. Instructors have to consider different foreign languages might not use the same learning strategies, as found in this study. Therefore, language teachers should recognize and make use of these differences to help language instruction.

It is also important for the learners to be conscious of the importance of language learning strategies and which learning strategies they have in hand to help them with their learning. A guide on learning strategies would be helpful for students to share with, and learn from each other.

Thus, the researcher suggested that more research is needed to understand the correlation among proficiency, motivation, and the use of language learning strategies for different foreign languages. It is also vital to find out the instructors' awareness on the perception of language learning strategies by their learners. Only when these teachers are conscious of and have knowledge of language learning strategies would they be able to help the students with the strategies. Finally, teaching materials could help to promote the use of the learning strategies.

References

Ainol Madziah Zubairi & Isarji Hj Sarudin (2009). Motivation To Learn A Foreign Language In Malaysia. *GEMA Online Journal of Language Studies. Volume 9(2).*

Chamot, A.U. & Küpper, L. (1989). Learning Strategies in Foreign Language Instruction. *Foreign Language Annals (22)* , 13-24.

Cook, V. (2001). *Second language learning and language teaching, 3rd edition. .* New York: Oxford University Press.

Ellis, G. & Sinclair, B. . (1989). *Learning to Learn English: a course in learner training.* New York: Cambridge University Press.

Green, J. M. & Oxford, R. . (1995). A closer look at learning strategies, L2 proficiency, and gender. *TESOL Quarterly, 29(2)* , 261-297.

Hismanoglu, M. (2000). Language Learning Strategies in Foreign Language Learning and Teaching. *The Internet TESL Journal, Vol. VI, No. 8 .*

Lee, K. & Oxford, R. (2008). Understanding EFL learners' strategy use and strategy awareness. *Asian EFL Journal, 10(1)* , 7-32.

Macaro, E. (2003). Strategies for language learning and for language use: revising the theoretical framework. *The modern language journal, 90 (3)* , 320-337.

Meschyan, G., & Hernandez, A. . (2002). Is native-language decoding skill related to second-language learning. *Journal of Educational Psychology, 94(1)* , 14-22.

Oh, J. (1992). Learning strategies used by university EFL students in Korea. . *Language Teaching (1)* , 3-53.

Oxford, R. & Crookal, D. (1989). Research on language learning strategies: methods, findings, and instructional issues. *The modern language journal 73(4)* , 404-419.

Oxford, R. L. (1989). Use of language learning strategies: a synthesis of students with implications for strategy training. *System, 17(2)* , 235-247.

Oxford, R. (1990). *Language learning strategies: what every teacher should know* . Massachussetts: Heinle and Heinle.

Oxford, R.L. & Ehrman, E. (1993). Second language research on individual differences. *Annual Review of Applied Linguistics (13)* , 188-205.

Rigney, J. (1978). Learner strategies: A theoretical perspective. In J. H.F. O'Neil, *Learning strategies* (pp. 165-205). New York: Academic Press.

Roswati Abdul Rashid, Radhiah Ismail & Noor Haslina Mohd Akhir (2007). Kepelbagaian Strategi Pembelajaran Tulisan Asas Bahasa Jepun (Hiragana): Satu Kajian Deskriptif. *3L Journal of Language Teaching, Linguistics and Literature (13). 1-27*

Shamis, W. A. (2003). Language learning strategy use in Palestine. *TESL-EJ 7(2)* , 3-21.

Wenden, A. (1985). Learner Strategies. *TESOL Newsletter, 19(5)* , 1-7.

Williams, M., Burden, R. & Lanvers, U. (2002). French Is the Language of Love and Stuff': Student Perceptions of Issues Related to Motivation in Learning a Foreign Language. *British Educational Research Journal*. 28(4), 503-528

Yang, M. N. (2007). Language learning strategies for junior college students in Taiwan: Investigating ethnicity and proficiency. *Asian EFL Journal, 9(2)* , 35-57.

Endospore Formation of *Candida orthopsilosis* and Cellular Morphology Differentiation using Staining Method of Dorner with Snyder's Modification

Giek Far Chan

Department of Biological Sciences, Faculty of Biosciences and Bioengineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia. Bionanotechnology Research Group, Sustainability Research Alliance, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.

Chai Fung Chin

Department of Biological Sciences, Faculty of Biosciences and Bioengineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.
Email: giekfar@utm.my

Abstract

Candida orthopsilosis is a relatively new species proposed in 2005 to replace *C. parapsilosis* group II. The yeast has been increasingly isolated from human body parts with great significance in virulence. In this study, we aimed to investigate the possibility of pathogenic *C. orthopsilosis* isolate AY2 in forming endospore after prolonged growth and to differentiate the different cellular morphology of the yeast by Dorner's staining method with Snyder's modification. Malachite staining was carried out to verify formation of endospores. The results showed that the yeast existed in typical yeast-like cell, blastospores and pseudohyphae forms. Blastospores and endospores were present in the culture grown in a sporulation medium containing 10 g l^{-1} of potassium acetate. Prolonged incubation of the yeasts in the medium resulted on formation of pseudohyphae and endospores. Dorner's staining method with Snyder's modification differentiated the presence of blastospores from vegetative yeast cells and pseudohyphae. To date, this is the first report to show the presence of endospores in *C. orthopsilosis*, as well as the use of Dorner's method with Snyder's modification to stain the yeast cells of different morphologies.

Keywords: Blastospore; *Candida orthopsilosis*; Dorner's staining method with Snyder's modification; endospore; pseudohyphae

Introduction

Candida orthopsilosis was being proposed as the new species in 2005 to replace *Candida parapsilosis* Type II based on the genotypic differences (Tavanti et al., 2005). *C. parapsilosis* was closely related to *C. parapsilosis* which is known to cause candidemia and invasive candidiasis, being the second in terms of prevalence after *C. albicans*. *C. orthopsilosis* was mostly recovered from blood, nails, skin, lungs, urine and indwelling catheters. The virulence level of *C. orthopsilosis* was similar to the virulence level of *C. parapsilosis* (Gomez-Lopez et al., 2008). In our previous study, *C. orthopsilosis* strain AY2 was co-isolated with *Aureobasidium pullulans* from the skin of an immunocompromised patient and was suspected to cause persistent skin infection (Chan et al., 2011). Strain AY2 was identified by 18S rRNA gene characterization and could be cultured in Sabouraud dextrose broth (Chan et al., 2011). In Malaysia, isolation of *C. orthopsilosis* from blood culture of two leukaemic patients was reported by Yong et al. (2008). Routinely, diagnosis of yeast requires isolation and observation of morphological characteristics. *C. orthopsilosis* was observed to show blastospores which sometimes sprouted randomly along with elongated pseudohyphae and giant cells containing a mass of mycelia were occasionally seen (Yong et al., 2008).

To date, morphological study on the pathogenic *C. orthopsilosis* remains lacking. Besides that, formation of endospore by *C. orthopsilosis* has never been reported. In this study, we attempted to explore on the morphology of *C. orthopsilosis* under prolonged growth in sporulation medium. Dorner's staining method with Snyder's modification was carried out for the first time to examine the culture morphology. The capability of the dimorphic cells of *C. orthopsilosis* containing blastospores and pseudohyphae to be stained by Dorner's staining method with Snyder's modification is presented here. The microscopy observation was compared with Malachite staining to investigate the possibility of endospore formation. The staining method allows further characterization of yeast morphology.

Materials and methods

Microorganism, media preparation and culture growth

C. orthopsilosis AY2 was deposited at Culture Collection of Laboratory of Microbiology, Universiti Teknologi Malaysia. The yeast was sub-cultured onto Sabouraud dextrose agar (SDA) plate and incubated at 30ºC for 48 h. The yeast was inoculated in 30 ml of YPG medium consists of 1% (w/v) yeast extract, 2% (w/v) peptone water and 2% (w/v) glucose. The inoculum was incubated at 30°C with shaking at 120 rpm for 3 d. OD_{600nm} of *C. orthopsilosis* was determined to be in the range of 0.25 and 0.3, and the cells were harvested by centrifugation for 5 min at 3000 rpm. Supernatant was decanted and the cells were washed in 20 ml of sterile distilled water. The washing step was repeated twice. The cells were suspended in 25 ml of sporulation medium consisting 10 g l^{-1} potassium acetate, 1 g l^{-1} yeast extract and 0.5 g l^{-1} glucose. The cells were incubated at 30°C with shaking at 120 rpm until 4 weeks. The yeast culture was sampled according to the time as shown in Fig. 1 and its morphology was observed after spore staining.

Dorner's staining method with Snyder's modification

Staining was carried out as described by Snyder (1934). The yeast cells were heat fixed on a glass slide and covered with a square of blotting paper. The blotting paper was

saturated with Ziehps Carbol Fuchsin (Fluka, USA) and steamed over a container of boiling paper for 5-10 min. More dye was added to keep the paper moist. The blotting paper was removed and the smear was decolorized with acid-alcohol (97 ml of 95% ethanol, 3 ml of concentrated hydrochloric acid) for 1 min, followed by rinsing with tap water. The smear was blotted dry and was saturated and dried with a thin 10% aqueous nigrosin (Fluka, USA) layer. The slide was examined using light microscope (Leica, USA). Vegetative cells are to be colorless, whereas endospores are to be pinkish-red in the blackish-dark background. The number of cells in red was counted to determine the percentage of endospores in the culture.

Malachite staining

Smear of *C. orthopsilosis* AY2 was prepared and heat fixed. Then, the smear was flooded with Malachite green for 5 min over boiling water and excessive stain was washed off. After that, the smear was counterstained with Safranin for 1 min, briefly washed and blot dried. Endopores formed were examined under light microscope (Leica, USA). Endospores were to be stained in green, and vegetative cells were to be stained in pink.

Results

C. orthopsilosis AY2 was able to grow in two different forms, namely blastospore and pseudohyphae. *C. orthopsilosis* AY2 was cultured in YPG medium for 3 d prior to transfer into sporulation medium. As the culturing was done at 30°C, most of the cells showed a typical yeast-like form (Fig. 2a). After transfer into sporulation medium, the yeast-like form was still seen (Fig. 2b). As shown in Fig. 2c and Fig. 2d, more blastospores of *C. orthopsilosis* that contain granules were observed after 1 week. Growth of the yeast in sporulation medium up to 28 days resulted in the observation of pseudohyphae form under microscopy examination (Fig. 2e).

Further, *C. orthopsilosis* AY2 of the above mentioned morphology was stained using Dorner's method with Snyder's modification. The percentage of cells in red is indicated in Table 1. As incubation in sporulation medium was prolonged, less and less vegetative cells were observed and more cells containing endospore were formed. The 3rd day culture of *C. orthopsilosis* AY2 showed that most of the yeast-like cells were in white, and not being stained in red. Some of the clusters were stained in red and these perhaps were old cells from the inoculum. As the day of incubation increased, most of the yeast cells formed blastospores and Fig. 3 shows the cell morphology of *C. orthopsilosis* AY2 observed after staining with Dorner's method with Snyder's modification. Clusters of cells (blastospores) were in red, indicating the method could stain blastospores. The vegetative cells and pseudohyphae observed remained unstained. For comparison, Malachite staining was done and the observations are shown in Fig. 4. The yeast cells were stained in pink with Safranin (Fig. 4a). Incubation in sporulation medium up to 14 days and beyond had resulted in the formation of endospores, which were stained in green with Malachite (Fig. 4b). After prolonged culturing in YPG medium, cells of *C. orthopsilosis* could form endospores which were observed in isolated clusters of yeast cells.

This study also showed the reliability of Malachite staining in determination of the presence of endospore in *C. orthopsilosis*. Dorner's staining method with Snyder's modification could stain blastospore in pinkish-red, however this should not be confused as endospore formation.

Discussion

In this study, *C. orthopsilosis* strain AY2 used in study of endospore formation was formerly isolated from an immunocompromised patient and identified by 18S rRNA characterization (Chan et al. 2011). Recently, the genome of strain AY2 was sequenced and the draft genome revealed high similarity to the reference genome of *C. orthopsilosis*. *C. orthopsilosis*, being closely related to *C. parapsilosis*, can be classified within the second group of *Candida* (CTG) clade. Other species in this group include *C. albicans*, *C. dubliniensis*, *C. tropicalis*, and *Lodderomyces elongisporus*, which are described as diploid and, for most, no sexual structure have been observed (Sai et al., 2011). The dimorphic yeast could reproduce asexually by budding and forming ellipsoid bud, as well as in the pseudohyphal form. Similar morphology observation on *C. orthopsilosis* has been reported by Yong et al. (2008). *C. parapsilosis*, a species closely related to *C. orthopsilosis*, also exists in either yeast or pseudohyphal forms (Kim et al., 2006). Blastospore is the budding form of unicellular yeast. Budding on a small selected site of blastospore surface involves the growth of new cellular material. Nuclear division follows and division of the parent and daughter cell by a septum results in the two cell units separate to form blastospores (Molero et al., 1998). Blastospore remained as the dorminant growth form of *C. orthopsilosis* AY2 in sporulation medium for nearly 3 weeks.

Towards the end of the growth of *C. orthopsilosis* AY2 in sporulation medium at 30°C, cylindrical outgrowth on the surface of the blastospores resulted the formation of elongated cells that appear as filamentous cell chains (pseudohyphae). Formation of pseudohyphae was also clearly seen among *C. orthopsilosis* AY2 cells cultured at higher temperature of 37°C in Sabouraud dextrose broth after 2 days (Chin, 2012). Laffey and Butler (2005) elucidated on the transition from yeast to pseudohyphal form of *C. parapsilosis* to occur in serum medium. This observation could probably be extrapolated to *C. orthopsilosis*, hence raising a great concern as the yeast has been reported to be a human pathogen. Induction of mycelia form is crossly linked to pathogenicity (Molero et al., 1998; Kumamoto and Vinces, 2005). Serum has also been shown to be the most effective inducer of filamentous growth of other pathogenic yeast including *C. albicans* (Kumamoto and Vinces, 2005). A study by Kim et al. (2006) revealed that amino acids, citrulline in particular, induced pseudohyphal morphogenesis in *C. parapsilosis*.

In the present study, sporulation medium that contains 10 g l^{-1} potassium acetate was chosen as culture media to investigate the endospore formation potential of *C. orthopsilosis* AY2. In the established model of *Saccharomyces cerevisiae*, when the diploid cells were transferred to acetate sporulation medium, the cell metabolized acetate as an important metabolite source immediately for synthesis of protein, nucleic acids, lipid and cellular debris (Esposito et al., 1969). The diploid strain can undergo developmental switch from vegetative growth to meiosis and ascospore formation depending on the presence of two alleles of the mating-type locus MAT a and MAT α, as well as the particular phase of the cell division cycle (Dickinson et al., 1983). Sporulation media that contained potassium acetate could increase the yield of asci in *Saccharomyces* and this suggested potassium was required during ascosporulation (McClary et al., 1959). In our study, potassium acetate may have an effect on the formation of endospores by *C. orthopsilosis* AY2. To date, the presence of endospores in the yeast stained using Malachite green is reported for the first time.

To the best of our knowledge, this is also the first time that Dorner's method with Snyder's modification was tested on *C. orthopsilosis* and the method could not differentiate the staining of blastospores from the endospores which was formed after prolonged growth in sporulation medium. Dorner's method with Snyder's modification was used to stain ascospores formed in sexual cycle of yeasts (Lonsane et al., 1972). Prior to this, there is no report on the use of Dorner's method with Snyder's modification for staining of blastospore. Generally, carbol fuchsin stains both endospores and vegetative cells pink. The acid-alcohol decolorizes the stain from vegetative cells, but not from the spores, and counter-staining with nigrosin results in a dark background. This may probably due to the cell wall composition difference between blastospore and vegetative cell. Blastospores of *C. orthopsilosis* may contain granules that could retain the carbol fuchsin stain used. The cell wall of *C. orthopsilosis* was reported to be made up of ß-1,3-glucan and chitin (Bizerra et al., 2011).

What could be the implication of the staining methods of *C. othopsilosis*? From the staining using Dorner's method with Snyder's modification, the vegetative cells and pseudohyphae of *C. orthopsilosis* could be differentiated from the blastospores. Hence, the staining method will be very useful for future research that requires the distinction of the yeast's cell morphology, for example in the study of biofilm formation and virulence. Biofilm formation of *C. orthopsilosis* has been reported by Lattif et al. (2010), and this could be the virulence factor contributing to the pathogenicity of the yeast. Biofilm of *C. orthopsilosis* was suggested to be mainly of aggregated blastospores (Lattif et al., 2010). A review by Nosek et al. (2009) reiterated that dimorphic transition of blastospore and pseudohyphae is closely linked to biofilm formation by *C. orthopsilosis*' close relative, *C. parapsilosis*.

In addition, morphological differentiation and endospore staining will be beneficial for future study on the heterogeneity or spore formation, i.e. mating within *C. orthopsilosis* group. Sai et al. (2011) related on two divergent groups of *C. orthopsilosis* as characterized by restriction patterns at mating-type-like (*MTL*). The *C. orthopsilosis* isolates used in their study were homozygotes for *MTL* and heterozygotes *MTL*a/α (Sai et al., 2011). Though mating was proposed to occur within the population structure of the *C. orthopsilosis* isolates tested, Sai and co-workers' finding revealed no supportive laboratory evidence, thus suggesting the current loss mating trait of *C. orthopsilosis*. Hence, more future investigation could be proposed by selecting strains to be used based on their morphology.

In conclusion, Dorner's method with Snyder's modification was successfully used to distinguish the morphology of *C. orthopsilosis* - blastospores and pseudohyphae, including vegetative cells. Malachite staining revealed the presence of endospore within cells after prolonged growth in sporulation medium.

Acknowledgements

References

Bizerra FC, Melo ASA, Katchburian E, Freymuller E, Straus AH, Takahashi HK, Colombo AL (2011) Changes in cell wall synthesis and ultrastructure during paradoxical growth effect of caspofungin on four different *Candida* species. Antimicrob Agents Chemother 55:302-310; doi:10.1128/AAC.00633-10

Chan GF, Puad MSA, Rashid NAA (2011) *Candida orthopsilosis* and *Aureobasidium pullulans* - Rare Fungal Pathogens Causing Persistent Skin Infection. Insight Infectious Diseases 1:1-4; doi:10.5567/INFECTIOUS-IK.2011.1.4

Chin CF (2012) Fungicidal activities of modified zeolites against *Candida orthopsilosis*. Dissertation Universiti Teknologi Malaysia

Dickinson JR, Dawes IW, Boyd ASF, Baxter RL (1983) ^{13}C NMR studies of acetate metabolism during sporulation of *Saccharomyces cerevisiae*. Proc Nati Acad Sci USA 80:5847-5851

Esposito MS, Esposito RE, Arnaud M, Halvorson H (1969) Acetate utilization and macromolecular synthesis during sporulation of yeast. J Bacteriol 100:180-186

Kim, S-K, Bissati KE, Mamoun CB (2006) Amino acids mediate colony and cell differentiation in the fungal pathogen *Candida parapsilosis*. Microbiology. 152:2885-2894; doi:10.1099/mic.0.29180-0

Kumamoto CA, Vinces MD (2005) Contributions of hyphae and hypha-co-regulated genes to *Candida albicans* virulence. Cell Microbiol 7:1546-1554; doi: 10.1111/j.1462-5822.2005.00616.x

Laffey SF, Butler G (2005) Phenotype switching affects biofilm formation by *Candida parapsilosis*. Microbiology 151:1073-1081; doi:10.1099/mic.0.27739-0

Lattif AA, Mukherjee PK, Chandra J, Swindell K, Lockhart SR, Diekema DJ, Pfaller MA, Ghannoum MA (2010) Characterizations of biofilms formed by *Candida parapsilosis*, *C. orthopsilosis* and *C. metapsilosis*. Int J Med Microbiol 300:265-270; doi:10.1016/j.ijmm.2009.09.001

Lonsane BK, Singh HD, Baruah JN, Iyengar MS (1972) Simple method for inducing ascospore formation in yeasts. Appl Microbiol 23:161-163

McClary DO, Nulty WL, Miller GR (1959) Effect of potassium versus sodium in the sporulation of *Saccharomyces*. J Bacteriol 78:362-368

Molero G, Diez-Orejas R, Navarro-Garcia F, Monteoliva L, Pla J, Gil C, Sanchez-Perez M, Nombela C (1998) *Candida albicans*: genetics, dimorphism and pathogenicity. Internatl Microbiol 1:95-106

Nosek J, Holesova Z, Kosa P, Gacser A, Tomaska L (2009) Biology and genetics of the pathogenic yeast *Candida parapsilosis*. Curr Genet 55:497-509; doi:10.1007/s00294-009-0268-4

Sai S, Holland LM, McGee CF, Lynch DB, Butler G (2011) Evolution of mating within the *Candida parapsilosis* species group. Eukaryot Cell 10:578-587; doi:10.1128/EC.00276-10

Snyder MA (1934) A modification of the Dorner spore stain. Stain Technol 9:71

Tavanti A, Davidson A D, Gow N AR, Maiden MCJ, Odds FC (2005) *Candida orthopsilosis* and *Candida metapsilosis* spp. nov. to replace *Candida parapsilosis* groups II and III. J Clin Microbiol 43:284-292; doi:10.1128/JCM.43.1.284–292.2005

Yong PV, Chong PP, Lau LY, Yeoh RS, Jamal F (2008) Molecular identification of *Candida orthopsilosis* isolated from blood culture. Mycopathologia 165:81-87; doi:10.1007/s11046-007-9086-8

APPENDIX
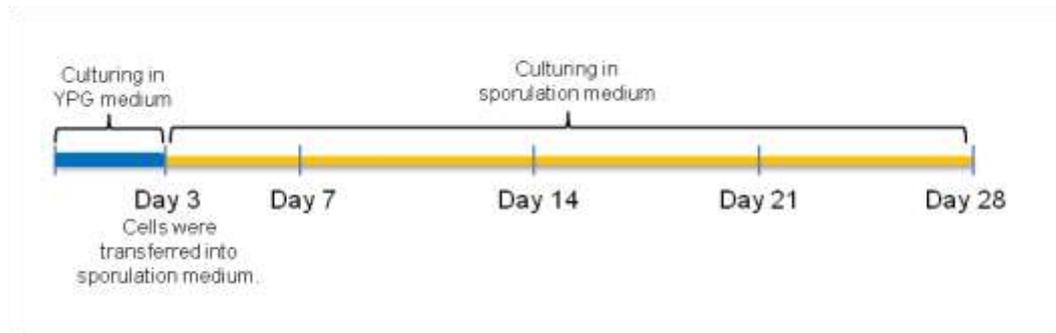
Fig. 1 Growth of *C. orthopsilosis* AY2 in YPG and sporulation media. Staining was done on cells sampled on the 7th, 14th, 21st and 28th day.
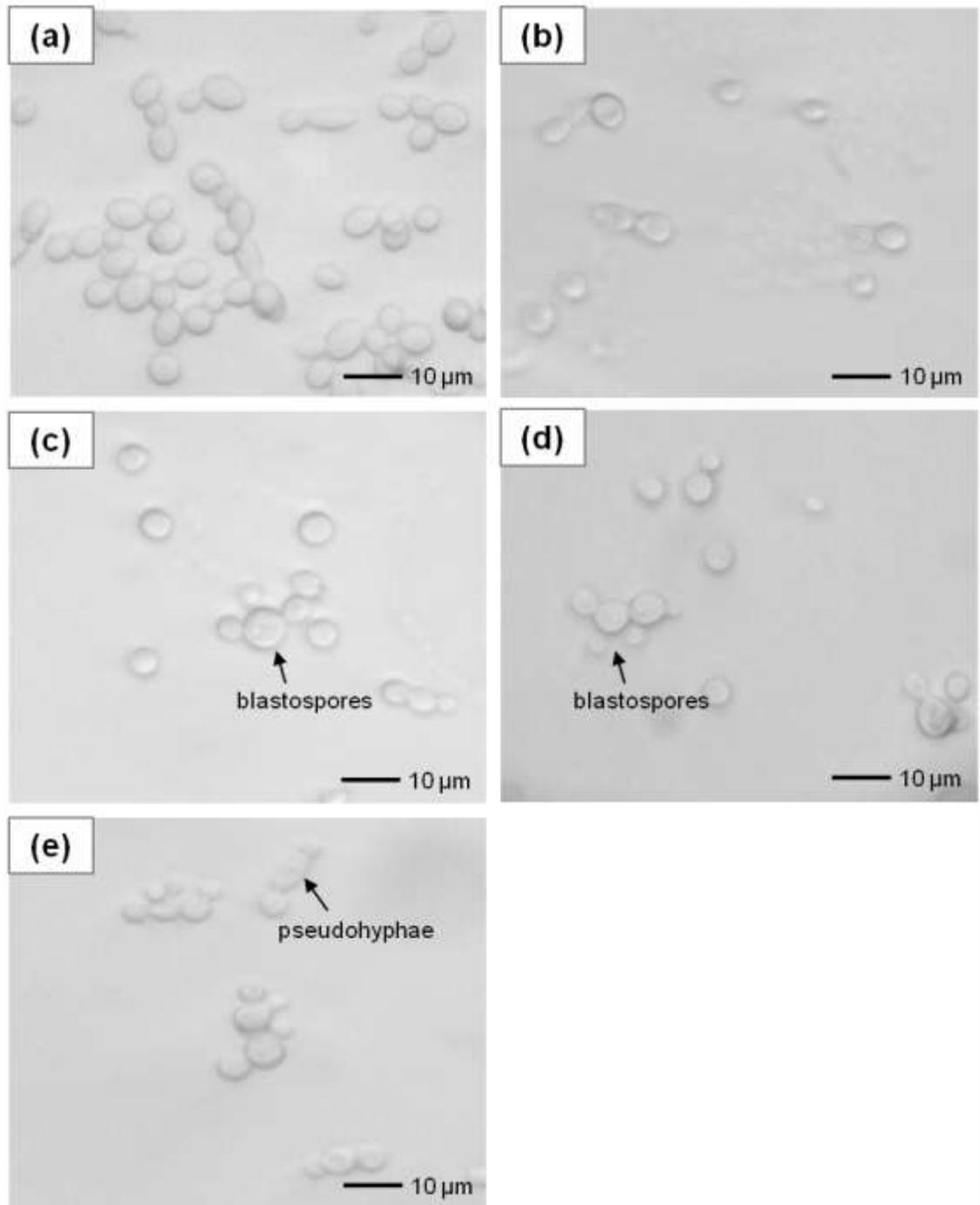
Fig. 2 Morphology of *C. orthopsilosis* AY2 grown in YPG and sporulation media. Cells were sampled on the 3rd (prior to transfer to sporulation medium), 7th, 14th, 21st and 28th days, respectively.
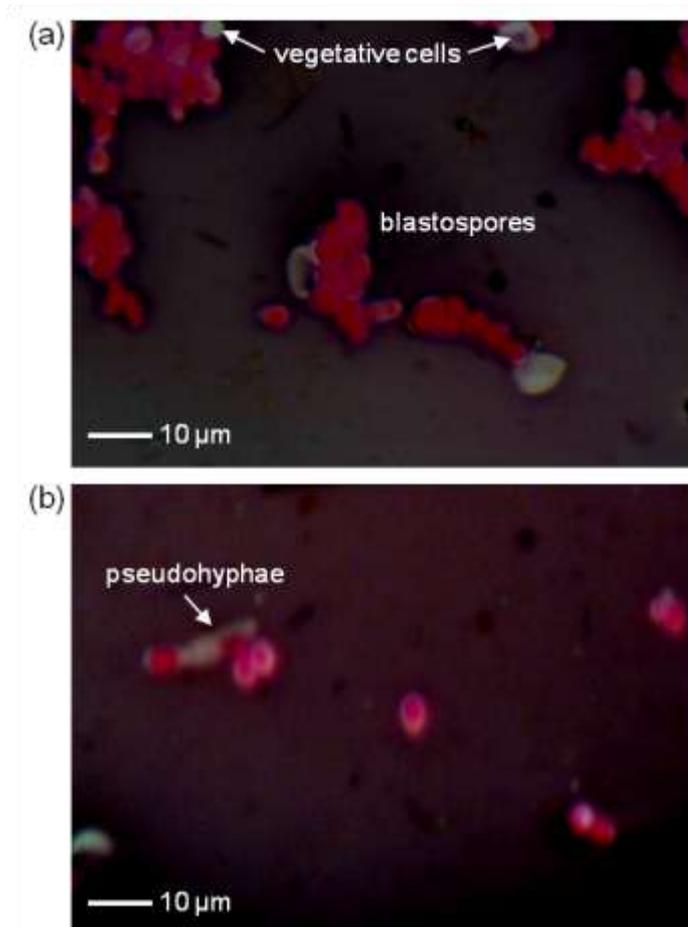
Fig. 3 Staining of *C. orthopsilosis* AY2 using Dorner's method with Snyder modification. Observation of cell morphology on the (a) 7th, and (b) 28th days, respectively.
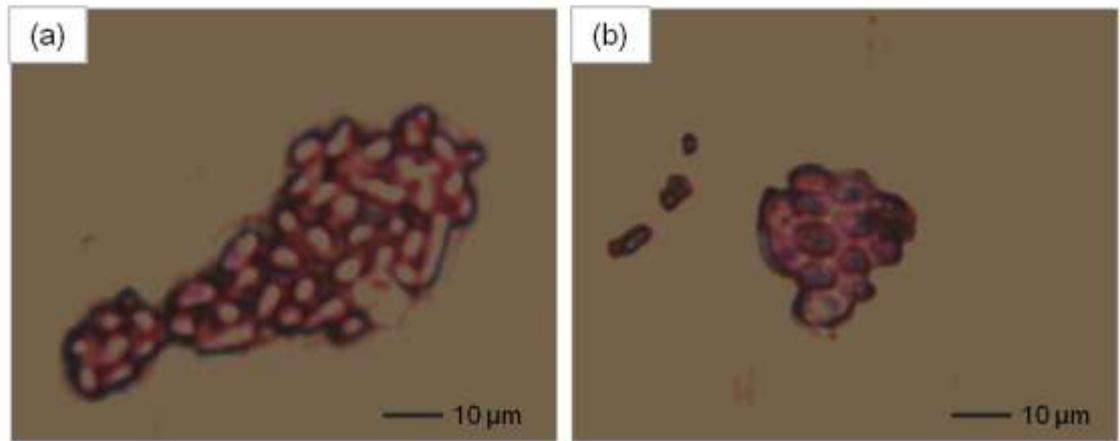
Fig. 4 Malachite staining of *C. orthopsilosis* AY2. Observation of cell morphology on the (a) 7th, and (b) 28th days, respectively.

Table 1 Staining of *C. orthopsilosis* AY2 after prolonged incubation at 30°C in the growth medium using Dorner's method with Snyder's modification. Values are means of twenty replicates ± standard deviation.

Medium	Day of culture	Percentage of "endospore" formed (%)*
YPG	3	38.93 ± 10.06
Sporulation m	7	52.93 ± 15.42
	14	59.21 ± 20.05
	21	69.45 ± 23.66
	28	81.71 ± 10.39

* Cells were stained in pink.

A Comparative Analysis of the Impact of Exchange Rate Volatility on the Export of Ghana and Nigeria

S .Olubanji Fajonyomi

fajonyomib@yahoo.co.uk

Department of Public Administration

Lagos State University, Lagos Nigeria

Sikiru O. Ashamu

Soyerinde2000@yahoo.com

James O. Abiola

joabiola@gmail.com

Department of Accounting and Finance

Lagos State University, Lagos, Nigeria.

Abstract

The paper investigates the impact of exchange rate volatility on the export of Ghana and Nigeria between 1980 and 2006. The study adopts Autoregressive Conditional Heteroscedaticity (ARCH) model to generate and test for volatility. Co integration and error correction model is used as the estimating technique. The ARCH result shows that exchange rate for the two countries are volatile and hence a measure of exchange rate volatility for each country was generated. The result of the co integration and error correction model shows the existence of long-run relationship between export and exchange rate volatility for both countries. In addition exchange rate volatility has a negative impact on the exports of both countries, while, exchange rate itself has positive and significant impact on both countries' export. The error correction model shows that the effect of exchange rate volatility is felt more on the Nigerian export in the short-run than Ghana.

Key Words: export, exchange rate volatility, negative impact, Autoregressive Conditional Heteroschedaticity model**.**

I. Introduction

The issue of exchange rate and its effect on growth has received much attentions from scholars in the recent past. However, findings have shown that attentions were paid more to exchange rate itself rather than its nature (i. e volatility). Egert and David (2005) emphasized the need to study the influence of exchange rate volatility on the growth of many developing countries since their economies are more dependent in nature. This according to him will enable the countries to strike a balance between exchange rate and economic growth in such a way that the overall economic performance of the nations can be promoted. Jhingan (1978) stressed that economic performance of developing nations can be given an accelerated promotion if the countries' exports improve. This according to him will make the countries more self dependent and reduce the possible negative effect that exchange rate fluctuations might have on the economies. Nigeria and Ghana, both Anglophone West African developing countries, share a lot of ideologies on issues around exchange rate and export. For instance the two countries both moved from era of fixed exchange rate to flexible exchange rate system in the late 1980s. Both countries experienced economic crises which partly reflected the breakdown of a stable exchange rate system and more importantly reflected imprudent policies adopted by governments in the two countries in the past, which rendered them less competitive in the world. In many advanced economies as well as developing economies the automatic adjustment in the exchange rate, guaranteed by the price-specie-flow mechanism under the fixed exchange rate system was lost following the breakdown of the dollar standard in 1973.

One after another economies started artificially adjusting exchange rates, aiming to correct the balance in international trade. This culminated in the flexible exchange rate. Again the two economies have been mono-economy in nature for a long period of time; while oil has constituted the major export in Nigeria, cocoa has been the major export commodity in Ghana. It is also very apparent that both countries are majorly primary goods exporter.

In Nigeria, empirical findings had suggested that the implementation of import liberalization policy promotes non-oil and manufactured export, (Rajapatirana, 1995). However (Oloyede 2004) noted that its simultaneous implementation with devaluation and exchange rate deregulations might not have yielded the desired results of promoting manufactured exports. This is because since Nigeria's real sector particularly the manufacturing sector heavily depends on imported input (most of which are domestic substitutes), the cost effects of devaluation and depreciation of Naira may outweigh the gains arising from import liberalization regardless of the provision of export incentives. This is because in the short-run devaluation contributed to high inflation rate which hinders export growth by reducing international competitiveness and profitability of existing and new investment in the export sector. The implication of the above is that there is the need to examine if exchange rate volatility does not neutralize the effect of import liberalization policy as a means of promoting Nigeria's export.

In Ghanaian economy, according to Egert (2005), the traditional view of exchange rate volatility is that a responsive exchange rate volatility serves as incentives and guide to investors on the effective way to strike a balance between trading and investing at home or abroad. The need to contend with a rise in exchange rate volatility becomes imperative because of the uncertainty of profits on contracts denominated in a foreign

currency. However, it appears there is still no consensus on the nature of the impact of exchange rate volatility on export.

Consequently, this paper compares the role of exchange rate volatility in export performance promotion those two economies that share so much in common. This is with a view to see if what pays-off in one country does not in the other and vice versa, and possibly see if one can borrow a leaf from the other. The rest of the paper is structured as follows

II. Some literature

Duane, Philip Lane & McIndoe (2006) investigated the impact of currency unions (Optimum Currency Region (OCA) exchange rates arrangements) on Irish trade patterns. In contrast to most of the multi-country panel studies, they did not find any impact of European Market Union (EMU) on trade. This, they argued is qualitatively consistent with the pattern noted by Baldwin (2006) that EMU has had a bigger impact on the 'core' member countries than on the peripheral member countries that have weaker economic linkages with the rest of the currency union. They however, acknowledge that the time period may be too short to pick up the EMU effect on Irish trade, but noted the importance of the need to re-visit the study in a few years.

Ogun (2004) examined the impact of real exchange rate on growth of non-oil export in Nigeria. Specifically, he analyzed the effect of real exchange rate misalignment and volatility on the growth of non-oil exports. He employed the standard trade theory of determination of export growth and two different measures of real exchange rate misalignment, one of which entails deviations of the purchasing power parity (PPP) and the other which is based on estimation of equilibrium real exchange rate (ERER). He reported that irrespective of the alternative measures of misalignment, volatility adversely affected the growth of Nigeria's non oil export.

Charles and cavallo *(2008)* used the Exponential Generalized Autoregressive Conditional Heterosedascity (EGARCH) model in establishing a relationship between exchange rate volatility and stock market volatility in Ghana. It was found that there is negative relationship between exchange rate volatility and stock market returns – a depreciation in the local currency lead to an increase in stock market returns in the long run. Whereas in the short run it reduces stock market returns. Additionally, there was volatility persistence in most of the macroeconomic variables; current period's rate has an effect on forecast variance of future rate. It was also revealed that an increase (decrease) in trade deficit and expectation in future rise in trade deficit will decrease (increase) stock market volatility. In addition, the consumer price index has a strong relationship with stock market volatility. This means that an increase in consumer price would lead to a rise in stock market volatility. Finally, there is the presence of leverage effect and volatility shocks in stock returns on the Ghana Stock Exchange.

Adjasi and Biekpe (2005) investigated the relationship between stock market returns and exchange rate movements in seven African countries. Co integration tests showed that in the long-run exchange rate depreciation leads to increases in stock market prices in some of the countries, and in the short-run, exchange rate depreciations reduce stock market returns. The study of Mishra (2004) indicated that stock return, exchange rate return, the demand for money and interest rate are related to each other though no consistent relationship exist between them. Furthermore, forecast error variance decomposition evidenced that exchange rate return affects the demand for money; interest

rate causes exchange rate to change; exchange rate affects the stock return; demand for money affects stock return; interest rate affects the stock return, and demand for money affects the interest rate.

Engle and Rangel (2005) examined the link between the unconditional volatility and a number of macroeconomic variables ,they discovered that the more volatile a macroeconomic variable is the more the significance it has on the macroeconomic stability of the country. Bercker and Clement (2005) extended the SPLINE GARCH model proposed by Engle and Rangel (2005) when they modeled stock market volatility conditional on macroeconomic conditions. They incorporate macroeconomic information directly into the estimation of such GARCH models. It was demonstrated that forecasts of macroeconomic variables can be easily incorporated into volatility forecasts for share index returns. Thus their model can lead to significantly different forecasts than traditional GARCH type volatility models.

Praveen's (2000) study examined the impact of devaluation on trade balance of some selected African countries, including Ghana. Following the work of Kreuger, Rawlins and Praveen (1983) specified and estimated an Almon Distributed lag process of trade balance with a set of monetary and fiscal policy variables and using annual data for the period 1960-1989Thet found that the real exchange rate depreciation did not have any impact on Ghana's trade balance in the year of the devaluation and therefore concluded that the J-curve effect appears not to be significant in the case of Ghana.

From the literature reviewed in this study, it appears many of the authors were more concerned with exchange rate rather than exchange rate volatility, few literature that were on exchange rate volatility were not on Nigerian economy. However, the nature and behavior of macroeconomic variables that is, how volatile they are appear to have influence on economic stability of a country Bercker and Clement (2005). Consequently, our study expands the view of past authors on exchange rate by incorporating its behaviors especially its volatile nature. Again, a cross country analysis used in our study that is comparative analysis of both Ghana and Nigeria will further broaden our view and provide a better understanding of how countries in the same region can benefit from strategies for managing exchange rate fluctuations.

III. Methodology

Sources of Data and Scope

The data on exchange rate, terms of trade, and interest rate were sourced from the world bank data tables and the Nigerian statistical bulletin 2008 edition. The data were collected from 1980 to 2006 because this is the period in the history of the two economies when they witnessed different government policies that have effect on their exchange rate system for instance within this period exchange rate was deregulated in both countries. The effect of these policies would have affected the behavior of exchange rate within this period.

This paper employs the conventional multiplicative export demand function with constant elasticities from standard trade theory/model of export determinants such as the one employed by Ogun (2004) with a slight modification. The theory was modified by not only making exchange rate a major determinant of export but also including its volatility. The inclusion of volatility is because it is our major variable interest. Again, control variables such as interest rate and terms of trade were also included, these

variables have been confirmed by literatures has important variables that can influence a country's export. Ezike and Amanh (2011).

The model is stated as;

$$X_i = \beta_o + \beta_1 EXR_i + \beta_2 VOL_i + \beta_3 TOT_i + \beta_4 IR_i + \mu\ldots\ldots(ii)$$

Where X   = value of export (proxied by Manufactured exports)

VOL   =   Measure of exchange rate volatility.

TOT   =   Terms of trade

EXR   =   Exchange rate

IR   =   Interest – rate

μ   =   Stochastic error term.

i   =   Individual country.

Estimation Technique

The estimation procedures employed is based on Johansen and Joselius co-integration analysis and the error correction model (ECM). However, before the application of co-integration, exchange rate is tested for volatility using the Autoregressive Conditional Heteroscedaticity (ARCH) and Generalized Autoregressive Conditional Heteroscedaticity. (GARCH) models

IV. Results and Discussion

Tests of Volatility of the Exchange Rates

Result of the volatility test in are presented in the table 1

Table 1: Result of the ARCH Model

Ghana		Nigeria	
Variance equation		Variance equation	
ARCH	4.56 (0.043)**	ARCH	4.72 (0.040)**
Diagnostic Test on Residuals		Diagnostic Test on Residuals	
Normality	54.41 (0.000)**	Normality	130.41 (0.000)**
Std dev.	0.268	Std dev.	0.526
ARCH LM test		ARCH LM test	
F- statistics	13.07 (0.001)**	F- statistics	6.41 (0.036)**

(**) statistical significance at both 5 and 10 percents

Source: Computed by author

The coefficients of the variance equations for both countries were significant at 0.05 level. This suggests existence of significant ARCH effects in the exchange rate data during the period under review. The presence of ARCH effect is an indication that volatility exists. The diagnostic tests on the residuals support the validity of the ARCH model; for instance the normality test is statistically significant which shows that the series are normally distributed. Also the low values of the standard deviation from the

normality tests for both countries indicate a proper spread in the series. In addition the ARCH test of residual showed a significant F value for both countries. This means that there is volatility clustering in the model; it further shows that error variances are correlated i.e. there is ARCH effect. With all these findings it means that the conditional variances (VOL) generated from the exchange rates of both countries can be chosen as measures of exchange rate volatility in the regression equation.

Time Series Properties of Variables in the Model

The Augmented Dickey Fuller test for unit root was conducted for the variables in the model at both levels, first and second difference as the case may be. .

Table 2

Augmented Dickey Fuller tests for stationarity with Intercept and Linear Trend
Unit root test result

Countries	Variable	*ADF* Statistics	Order of Integration
Ghana	X	-10.3166	I (2)**
	EXR	-4.6675	I (2)**
	TOT	- 5.4451	I (1)*
	IR	- 4.3715	I (1)*
	VOL	-5.2273	I (1)*
Nigeria	X	-3.7355	I (1)*
	EXR	-4.6675	I (2)**
	TOT	- 3.6931	I (1)*
	IR	- 4.8303	I (1)*
	VOL	-4.6669	I (1)*

Source: Computed from data

NOTE: *ADF critical value at 5% is − 3.6219;   / **: Stationary after the second difference*

*: Stationary after the first difference

The test in table 2 was conducted with the assumption of constant and trend in the series. This is so because each of the variables shows a relationship with line that is trended. The results in table 2 therefore indicate that in both Nigerian and Ghanaian economies all variables are non-stationery at their levels. This is so as their ADF statistics are all less negative than the critical values at the 0.05 level. The economic implication of non-stationary series is that there is a prolonged or sustained shock if there is any disturbance to the variable. Thus all the variables exhibit persistent shock.

The result of the Johansen maximum likelihood cointegration test and the associated error correction model are presented.

Cointegration Rank Test on Export Performance and Exchange Rate Volatility I

The test is conducted using the Johansen cointegration technique since the model is multivariate. The result of the multivariate cointegration is presented in table 3

Table 3: Johansen Multivariate Cointegration Rank Test

Countries	Кmax				Trace			
	H0	H1	Stat	0.05	Ho	H1	Stat	0.05
Ghana	r=0	r=1	38.8010*	37.0700*	r=0	r =1	91.0486*	82.2300
	r ≤1	r=2	21.5148	31.0000	r≤1	r =2	52.2476.	58.9300
	r≤ 2	r=3	15.7880	24.3500	r≤2	r = 3	30.7328	39.3300
	r ≤3	r=4	11.4889	18.3300	r≤3	r = 4	14.9448	23.8300
Nigeria	r=0	r=1	95.2725*	37.0700*	r=0	r =1	147.8610*	82.2300
	r≤1	r=2	23.9797	31.0000	r≤1	r =2	52.5885	58.9300
	r≤2	r=3	13.3512	24.3500	r≤2	r = 3	28.6088	39.3300
	r≤3	r=4	11.2961	18.3300	r≤3	r = 4	15.2576	23.8300

Source: Computed from data

Asterisk (*) indicates statistical significance at the 0.05 level.

The LR test of Johansen is based on both trace statistics and maximal engel value. The null hypothesis of no cointegration is rejected at r = 0, since at this level, the trace test and maximal engel value are greater than their respective critical values at 0.05 level of significance. Thus the test indicates 1 cointegrating equation. The evidence of cointegration indicates that in both Nigeria and Ghana, exchange rate volatility will influence export in the long run when it included in a package of variables such as interest rate and terms of trade.

Cointegration Regressions

The cointegrating equation normalized to Ghanaian export is shown in equation 2.

$$X = -402.2827 + 0.035EXR - 120.020VOL + 35.640IR + 13.34TOT \qquad \cdots 2$$
$$(161.41)* \quad (0.01274)* \quad (135.58)* \quad (4.7563)* \quad (1.0691)*$$

$$R^2 = 0.94 \qquad F(4, 22)\ 90.83668\ (0.000) \qquad D.W = 2.1$$

From the equation, it is clear that in the long-run, exchange rate impact positively on export. The result further shows that the effect of exchange rate on Ghanaian export is significant at 5% level of significant level. The estimated coefficient of exchange rate being 0.035 means that a unit increase in the exchange rate will lead to about 3% rise in the export of Ghana this conforms to the apriori expectation. The interest rate and terms of trade both exhibited a direct relationship with the Ghana export. Their coefficients are also statistically significant at 5% level. However, the measure of exchange rate volatility is the only variable in the estimated model that has an inverse relationship with the Ghana export though the impact is not significant but It simply means that exchange rate volatility in Ghanaian economy is dis-incentive to local production and consequently affecting export adversely.

This conforms to the apriori expectation.

The cointegrating equation normalized to Nigerian export is shown in equation 3

$$X = 2853.91 + 742.40EXR - 255.02VOL - 125.3IR - 341.90TOT \quad \cdots 3$$
$$(1205.41)* \quad (53.6701)* \quad (52.201)* \quad (53.741)* \quad (19.561)*$$

$$R^2 = 0.91 \qquad F(4,22)\ 60.1623\ (0.000) \qquad D.W = 1.7$$

The regression equation 3 shows that, exchange rate impact positively on export. The result further shows that the effect of exchange rate on Nigerian export is significant. Note that the non oil export is used in our analysis. The interest rate exhibited an inverse relationship with the export .It should be noted that the interest rate used is the lending rate of the bank. The empirical result shows that terms of trade has an inverse relationship with the export. The coefficient is not statistically significant at 0.05 but significant at 0.01 significant level. This also conforms with the apriori expectation. The coefficient of measure of exchange rate volatility in the Nigerian economy exhibited an inverse relationship with Nigerians export. The effect is statistically significant at 5% level.

Test of Overall Statistical Significance

The values of the R square are 0.94 and 0.91 in Ghana and Nigeria respectively. This means that systemic variations in the export is explained to the tune of about 94% and 91% respectively by the exchange rate volatility, exchange rate, and other variables such as interest rate and terms of trade. Expectedly, the F statistics value indicates that the models are statistically significant at 0.05 level. The Durbin Watson values of 2.1 and 1.7 in Ghana and Nigeria respectively is an indication that the model is not having the problem of auto-correlation.

Since all the variables included in the model are stationary at their first and second differences, we therefore estimate the short-run dynamics i.e. the error-correction mechanism (ECM). The results are given in Table 4

Error Correction Mechanism

The evidence of cointegration indicates that export will be influenced by exchange rate volatility in both economies in the long run. When cointegration exists, according to Engle-Granger ECM can be used to analyse the dynamic specification. The ECM is specified in the parsimonious form. The results are presented in table 4.

Table 4   ECM Parsimonious Model

Countries	Variable	Coefficient	Std Error	t-stat	Prob
Ghana	X(-1)	1.3204	3.3403	0.3953	0.697
	EXR(-2)	0.1271	0.1447	0.8784	0.391
	VOL(-2)	-455.65	413.43	-1.1021	0.285
	IR(-1)	-49.484	123.198	-0.40166	0.693
	TOT(-1)	-20.1050	43.3308	-0.46399	0.648
	ECM(-1)	-1.5653	3.2630	-0.47972	0.637
	C	1965.9	1452.3	1.3537	0.193
Nigeria	X(-1)	1.2814	0.1226	10.4535	0.000
	EXR(-2)	-105.229	97.5059	-1.0792	0.295
	IR(-2)	105.6341	218.562	0.4833	0.635
	TOT(-1)	125.845	97.2631	1.294	0.212
	VOL(-1)	-613.077	270.4829	2.2666	0.036
	ECM(-1)	-1.2019	0.1509	-7.9627	0.000
	C	-1380.1	5951.3	-2.3222	0.32

Ghana: R^2 = 0.65; F. stat = 5.6453 Prob. of F. stat. = .002

Nigeria: R^2 = .0.98; F. stat = 268.61 Prob. of F. stat. = .000

It appears that the overall impact of exchange rate volatility on Nigerian export is also very high in the short-run i.e 0.98 just like in the long run when it is about 0.91. However, it shows that the high negative impact is sustained from the short-run to the long-run. In the Ghanaian economy the short run R square of 0.65 is lower than that of the long run which is 0.94. Hence, the impact of exchange rate volatility is felt more in the long run in the Ghanaian economy than in the short run.

The ECM coefficients for both countries are well defined or are negative. The coefficient is used to determine the speed and direction of adjustment to equilibrium when there is disequilibrium. The ECM coefficient is -0.2653 for Ghana -0.6019 for Nigeria. The negative sign in the ECM indicate that the adjustment is in the right direction to restore the long-run relationship.

The economic implication of this result is that there was a disequilibrium in previous export value since ECM coefficient is non – zero in which case, some changes in exchange rates are necessary to restore equilibrium since the coefficient of ECM is less than zero.

Comparative Analysis for Both Countries
Comparatively, the findings in this paper have shown that there are some similarity and some clear difference between the two countries when we considered the impact of exchange rate volatility on their exports. Firstly, a measure of exchange rate volatility derived from both countries shows that exchange rate is actually volatile in the two countries through the empirical confirmation of presence of ARCH effects on the exchange rate models. Secondly, the long run regression equation shows that exchange rate volatility has a significant negative impact on the export in Nigeria. But, this is not

the case in the Ghanaian economy where the empirical result shows that exchange rate volatility has an insignificant negative impact on the country's export. This result might not be unconnected with the recent improvement in the Ghanaians domestic export especially in the manufacturing sector where a positive growth rate has been recorded. Praveen(2000) asserted that the effort of the Ghanaian government in diversifying the economy is yielding positive result due to sustainable supply of power and improvement in other infrastructural facilities.

Conversely, the Nigerian economy has been witnessing a fall in domestic output for some periods now. For instance, the Central Bank of Nigeria 2004 stated that the capacity utilization in the Nigerian manufacturing sector has been decreasing over the years it was even amazingly negative in 1998. Again the dearth in the supply of basic social amenities has been a major problem confronting the Nigerian economy. For instance Dunlop Nig PLC and a big Textile mill which are giants in the Nigerian manufacturing sector moved to Ghana in 2010 due to epileptic supply of power which had increased their cost of production significantly. All these might have accounted for the significant negative effect of exchange rate volatility on the Nigerian export. Thirdly, the parsimonious model indicates that exchange rate volatility had a significant impact on the Nigerian export both in the long and short runs. But in the Ghanaian economy, it appears that exchange rate volatility has a more significant impact on the economy in the long run than in the short run. This is corroborated by the coefficients of the ECM which is not statistically significant in the Ghanaian economy but significant in the Nigerian economy. The exchange rate of both countries has a positive and significant impact on their exports. This supports the view that exchange rate increase connotes a depreciation of the value of home currency which by implication should boost exports.

Finally exchange rate volatility has been shown to have inverse relationship with the exports of the two countries. This finding is in support of the literature and the theoretical developments which suggest a debilitating impact of exchange volatility on trade flows. In De Grauwe's (1988) formulation, the results suggest the dominance of the substitution effect over income effect. This implies that exchange rate volatility constraints market participants to retrenching into domestic activities. However, several authors have obtained results that suggest that exchange rate volatility impedes exports. For instance, Nabili and Varoudakis (2002) obtained results showing that exchange rate volatility restrained manufacture export in Middle East and North African countries.

V. Conclusion and Policy Recommendations

Since the findings in this study have confirmed a significant and positive relationship between the two countries' export and their respective exchange rate therefore, devaluation will promote export, but according to Balogun (2007) a lot of caution must be exercised in administering the devaluation policy so that it will not lead to depression of bilateral trade between the home countries and other country. In other words a proper analysis of the trade between a country and another must be thoroughly done so as to see if devaluation will actually induce export to the benefit of the growth of country's economy.

The existence of parallel markets has constituted a major problem confronting exchange rate administration tespecially in Nigeria. The results of this paper have shown that any problem that results from the exchange rate administration will significantly affect the two countries' exports. Consequently, the activities of the parallel market

operations which form a major distortion in exchange rate administration should be dealt with decisively so that the effect of the government policies can be well felt on exchange rate administration, especially in Nigeria.

The fact that Nigeria and Ghana are known to be exporters of primary agricultural and mineral production has been described by Balogun (2004) as one or the major problems confronting the exports of these two countries. A boost in local production can be achieved through massive investment in the real sector of the economy.   The establishment of Ghana investment promotion Centre and Nigeria investment promotion commission are steps in the right direction but the effects have not been effectively felt, especially in Nigeria. The investment friendly environment which prevails in Ghana has led to a boost in their manufacturing sector's contribution to total export which has increased from 6% in 2004 to 8.5% in 2006 (Source?). As earlier stated the massive exit of some manufacturing firms from the Nigeria economy in the recent times due to insecurity and poor infrastructures have compounded the problem of domestic export of Nigeria.

References

Adjasi,Y and Biekpe, R (2005) Relationship Between Stock Market Returns And Exchange Rate Movements In Seven African Countries *African Journal of Economic Policy* 4.1: 29-59

Ajakaiye O. (2001): "Impact of exchange rate depreciation on Sectoral prices" *NISER Monograph series (1968-2000).*

Baldwin,R.(2006), "In or out Does it matter An evidence –Based Analysis of the Euro's Trade Effects". *Centre for Economic policy Research, London*

Balogun A,H (2004). "Exchange Rate variability and Trade; Why is it so difficult to find Any Relationship?" Working Paper Series, Working Paper 2006-8 *23.927-936*

Balogun, E. D. (2004) Effects of Exchange Rate policy on Bilateral Export Trade of WAMZ countries. *Nigerian Institute for Social and Economic Research Volume 1 No. 12*

Bercker, H and Clement, R (2005): "Real and monetary determinants of real exchange rate behaviour", *Journal of Development Economics* 29: 311-341.

CBN Annual Report & Statement of Accounts for the years ended 31/12/1980-31/12/2004.

Charles,D and Cavallo, S. *(2008)* Real exchange rate behaviour and economic performance in Ghanaian Economic Development and Cultural Change. *Journal of Economic and Social Studies* 39:61-76.

Chou,W.L.(2000) "Exchange Rate variability and china's Exports". *Journal of comparative Economics 28.61-79*

De Grauwes, R (1988) Determinants of real exchange rates in South Africa: A short-run and long-run analysis. *African Journal of Economic Policy* 4.1:1-27

Doroodian K.(1999): Does Exchange Rate volatility Deter International trade in Developing countries. *Journal of Asian Economics 10.465-474*

Duane, C,Philip R.Lane & Tara McIndoe (2006) Currency Unions and Irish External Trade Institute for International Integration studies (111s)*Discussion paper No. 189)*

Egert, F and David, T (2005): *The Theory of international Trade*, A Survey of Contemporary Economics. Journal of African Economies Supplement to 6.3:74-120.

Fagbemiro. Y (2006): Effect of Exchange rate Policy on Export Performance in Nigeria: A Co integration Analysis: *Nigerian Journal of Economics and social Sciences. Vol 4, No. 32*

Fontaigne,L.G. and M.Freudenbery (1999): "Endogenous Symmetry Of Stocks in a Monetary Union" *Economics Review 10(3).263-287*

Jhingan, M.L. (1978) *Macroeconomic Theory*,11th Revised Edition,© M.L Jhingan vrinda publications, New Delhi,pp.773-787

Klein,M.W. (1990): "Sectoral Effects of Exchange Rate Volatility on United States Exports" *Journal of International Monetary Economics and Finance 9.229-308*

Komolafe T. (1996): "The Role of Exchange rate in Fostering External Adjustment in Nigeria" *Nigerian Journal of Economics and Social Sciences Vol 1, No. 134*

Kreuger,D., Rawlins,K. and Praveen. J (1983) Determinants of real exchange rate in Ghana. AERC Interim Report, Nairobi Dec. 5-13 1992.

Mc Kenzie,M.D.(1998): "The impact of Exchange Rate volatility on Australian Trade flows" *Journal of International Financial Markets in Institutions and money 8. 21-38*

Mishra, H. (2004): "Exchange Rate Reform, Parallel Markets and Inflation in Africa: The Case of Ghana" World Bank Working Papers, WPS 427, May.

Nabili, D. and Varoudakis, S. (2002): "Exchange-Rate Management and Manufactures Exports in sub-Saharan Africa" Development Centre Technical Papers. 134. Paris.: OECD

National Center for Economic Management and Administration, Ibadan, Nigeria

Obadan M. I.,(1998): " Real Exchange rate in Nigeria, A Preliminary Study*"*. Monograph Series No.6.

Ogun O. (2004): Real Exchange Rate Behavior and Non-oil Export Growth in Nigeria". *African Journal of Economic Policy. 11 (i)* pp 82

Okoroafo,S.C.(1990) The Status and Prospects for Success of Recent Economic Reform Policies in Sub-Sahara African National. *Journal of Economics and International Relations*,3 121-130

Oliver M. and Andrew Mold (1990): Explaining Africa's export performance. *Journal of comparative Economics 56.78-92*

Oloyede J.A. (2004): ``Effect of Financial Liberalization on the Performance of the Nigerian manufacturing Industries`` Journal of Economic Management, 2 (1):15-22.

Omoniyi and Ogunigbade (2003): "The Dynamics of Exchange rate and Inflationary Spiral in Nigeria (1970-1998). AERC Research pape*r* 82

Praveen, J.(2005). Real Impact of Devaluation on Trade Balance of Some Selected African countries, *Journal of Development Economics* 29: 311-341.

Rajapatirana, D. (1995). Exchange-Rate Management and Manufactures Exports in sub-Saharan Africa, Development Centre Technical Papers. 134. Paris.: OECD

Siregar,R and Rajan R.S. (2002) "Impact of Exchange Rate volatility on Indonesia's Trade Performance in the 1990's". *Centre for International Economic studies Discussion paper 0205*

Todaro M. (2004): *The Theory of Economic Development* Mc Graw *Publishers, New York.*(19th Edition).

The Imperative of Good Performance for female Political Leaders in Governance for National Development in Nigeria

Taiwo Olusegun Stephen

Department of Philosophy, Adekunle Ajasin University,

Akungba-Akoko, Ondo State, Nigeria.

08054616522

oluseguntik2001@yahoo.com

Abstract

Some strategies were suggested in an earlier paper titled "Political leadership of women as panacea to their political empowerment". These are among others policy affirmative action of proportionate ration or 30% representative to be employed to increase the total representation seats in each of the legislative seats, in each of the legislative houses, executive arm, party hierarchy and structure reserved for women for a trial period up from year 2011 democratic dispensation. Women should set goals, etc. Following up the above, President Jonathan appointed women to constitute 35% of his cabinet. In fact they are 13 in number. The position we are canvassing here is that there should be good performance from the female political leaders in the government be it in legislative houses, executive arm, judiciary, party hierarchy and any decision-making structure women found themselves. This would boast gender and national development in the country for political opportunity for women in Nigeria.

Introduction

In an earlier paper titled "Political leadership as panacea to Nigerian Woman Political empowerment" I had suggested the following strategies to adopt as far as political leadership for women is concerned in Nigeria:

1.   Policy affirmative action of proportionate ration or 30% representative will be employed to increase the total representation seats in each of the legislative seats, in each of the legislative houses, executive arm, party hierarchy and structure shall be reserved for women for a trial period up to the year 2010.

2.   Increasing the number of women standing for election would ultimately increase the success rate and representation of women in public leadership. Women can achieve this through the following ways:

(a)   Urging parties to set clear rules for selecting candidates.

(b)   Pressing for quotas for women's representation on party lists.

(c)   Pressing for equal space in the party executive.

(d)   Rejecting non-vital and non-strategic party positions and seeks to occupy better positions in the party.

(e)   Pressing for more female friendly party manifestos and

(f)   Pressing for incentives for parties that present a party nomination list with adequate representation in public office.

3.   Women need to work with men as partners. The starting point should be to seek the cooperation of men who are supportive of women in politics and who truly believe in gender equitable representation in public office.

4.   Women should set goals. In goal-setting, it is not so much the achievement of the goal that matters as much as the changes that it produces in women. Goals inspire us to change our thinking and our direction[1].

In a similar paper Lewu Alaba Yetunde in "Nigerian Women in Politics: A Study of the Role of Women in President Obasanjo's Administration, 1999-2003" argued forcefully that there is need for:

i.   Reworking of electoral regulations and practices to eliminate obstacles to women's political participation.

ii.   Open and accountable financial systems and equitable financial support for women in politics.

Other steps needed she opined to remedy the persistent low political participation of women include the following: education, legal and economic empowerment, human rights and social agenda.[2]

One can empirically confirm that strategies suggested above are working and some for future purposes. We have seen impressive numbers of women in national parliaments with Rwanda setting a world record of up to 56% followed by countries such as South Africa at 42%, Mozambique 39%. Other African countries include Burundi 36% and Uganda 31%. The efforts of President Jonathan in appointing women to constitute 35% of his cabinet are signs of political participation of women in politics. 13 women took strategic positions in his cabinet. The position to be canvassed here therefore is that once there is good performance from the female political leaders in governance, there

would be gender and national development in the political opportunity for women in Nigeria. But let us look at the State policies on women by Nigerian government.

State Policies on Women in Nigeria

The Nigerian government has always at the policy formulation shown interest in women issues. Nigeria participated in all United Nations international meetings on women issues. Be it the United Nations "Declaration of the Elimination of Discrimination against Women" in 1967, the United Nations "Declaration of the year 1975 as the International Year of Women"; the 1976-1989 as the United Nations' Decade for Women; the 1984 African Regional Conference in Arusha, Tanzania, jointly organized by the United Nations Economic Commission for Africa. The United Nations Conference on Women Development in Cairo, Egypt 1994, the Beijing Conference in 1995 and the International Women's Day celebration every year. United Nations Conferences on the Status of Women in New York, from 28th February – 2nd March, 2000, "Women 2000: Gender Equality, Development and Peace for the 21st century, New York, from 28th February – 17th March, 2000.

The establishment of the multi-purpose centres in 1981, the Better Life for Rural Women and initiatives of various programmes by the First Ladies of (President, Governors, Local Government Chairmen, etc) are not left behind. The initiatives of and important use of women in cabinet as ministers and advisers by Obasanjo regime 1999-2007, Yar'Adua's and now Jonathan's regime 2007-2011 and 2011-2015.

Nigerian government not only assists in conflict resolution in Liberia in ending the bloody reign of Charles Taylor but also in assisting in electing the first ever female African President – Ellen Johnson-Sirleaf. Thus Liberia recognized the role by conferring honour on President Goodluck Ebele Jonathan.

Good Performance: The Way Forward

By having good performance, the women (including women in legislative, judiciary etc) would show authentic democracy which is participatory in nature because it is a form of democracy that takes the decision of political leaders (female and men) and good governance to the grass root. The good performance begins to develop a democratic culture. This democratic culture is an embodiment of a sound culture as Bernard Eugune Meland expressed that:

> *A sound culture is … (a) democratic in its organization of life; (b) concern for the well-being of its citizens, that is, attentive to the standard of living particularly as this applies to health, comfort and security; (c) and adequately industrialized to facilitate the production and distribution of goods so that both democracy and human well-being might be assured.3*

Some of the female ministers hold key strategic positions such as Aviation, Education, Finance, Petroleum, Land & Housing, Women Affairs, Environment so also assisting in Niger Delta, Defence, FCT, etc. This to me are key areas of endeavors for these women to perform significantly to re-echo the word of Alhaja Sinatu Ojikutu former Deputy Governor of Lagos state who said "women are up to the task, there are ministries men had dominated all along, like the mineral sector, telecommunications, Petroleum etc. A woman can be minister of economic planning; some of us (women) are economists by training. There are many fields in which women can excel"[4].

We all witnessed what Mrs. Ngozi Okonjo-Iwuala did for President Olusegun Obasanjo's government and Nigeria in helping cancelling Nigerian debts. We are also witnessing global meltdown happening throughout the world – Greece, Ireland, U.S.A. Portugal and Spain are around the corner. The debt crisis is creating warnings from IMF and World Bank on the need for countries not to experience 2 dip recessions. If Greece defaults in her bail out, it would affect U.S.A., China, Japan, Germany, France, and other countries. I believe this is one area Mrs. Ngozi Okonjo-Iwuala's expertise in World Bank is needed to stabilize Nigerian economy not to crumble from the fall out of global meltdown.

Some Obstacles to the progress

But despite the progress we have painted above, the hopes of more women in legislative, executive, decision-making body is very low. Let us compare again the summary of gender participation in election contests in one state from the geo-political zone in the 2011 election.

Table I: Participation in election contests by gender in Ogun State.

Political Post	Contested		Elected	
	Male	Female	Male	Female
State Governor	19	00	01	00
Deputy Governor	19	00	01	00
Senate: Ogun North	10	01	01	00
Ogun South	06	02	01	00
Ogun Central	08	01	01	00
Total contestants for 3 senatorial seats	22	03	03	00
House of Representative 09 Federal constituencies	59	05	09	00
State House of Assembly	126	07	25	01

Table II   Participation in election contests by gender in Enugu State.

Political Post	Contested		Elected	
	Male	Female	Male	Female
State Governor	16	00	01	00
Deputy Governor	16	00	01	00
Senate: Enugu North-East	03	00	01	00
Enugu North-West	06	00	01	00
Enugu South	02	01	00	01
Total contestants for 3 senatorial seats	11	01	02	01
House of Representative 8 Federal constituencies	64	10	08	00
State House of Assembly	160	10	24	02

Table III   Participation in election contests by gender in Rivers State.

Political Post	Contested		Elected	
	Male	Female	Male	Female
State Governor	28	03	01	00
Deputy Governor	28	00	01	00
Senate: Rivers East	06	00	01	00
Rivers West	07	00	01	00
Rivers South	07	00	01	00
Total contestants for 3 senatorial seats	20	00	03	00
House of Representative 13 Federal constituencies	60	15	12	01
State House of Assembly	100	05	28	01

Table IV   Participation in election contests by gender in Kwara State.

Political Post	Contested		Elected	
	Male	Female	Male	Female
State Governor	15	00	01	00
Deputy Governor	15	00	01	00
Senate: Kwara North-East	06	00	01	00
Kwara North-West	07	00	01	00
Kwara Central	03	02	00	01
Total contestants for 3 senatorial seats	20	00	03	00
House of Representative 06 Federal constituencies	38	01	06	00
State House of Assembly	100	05	28	01

Table V   Participation in election contests by gender in Kaduna State.

Political Post	Contested		Elected	
	Male	Female	Male	Female
State Governor	14	03	01	00
Deputy Governor	14	00	01	00
Senate: Kaduna East	06	00	01	00
Kaduna West	07	00	01	00
Kaduna Central	10	00	01	00
Total contestants for 3 senatorial seats	23	00	03	00
House of Representative 16 Federal constituencies	58	01	16	00
State House of Assembly	100	05	28	00

Table VI   Participation in election contests by gender in Yobe State[5].

Political Post	Contested		Elected	
	Male	Female	Male	Female
State Governor	06	03	01	00
Deputy Governor	06	00	01	00
Senate: Yobe East	05	00	01	00
Yobe West	05	00	01	00
Yobe North	10	00	01	00
Total contestants for 3 senatorial seats	20	00	03	00
House of Representative 6 Federal constituencies	20	02	05	01
State House of Assembly	100	05	28	01

Source:http://www.incenigeria.org/index.php?do=publication&id=73&title=2 011%20Election20%candidates&cat-id=16, retrieved on 23rd August, 2011.

The attempt above is not to generalize the results from 6 States with the other diverse 36 States which sometimes are the socialization process and foundational stone to State political participation, the trend we emphasize here is the low levels of participation of women in the election contents at the party level.

In addition to the above, reports show that there are five countries you cannot successfully raise women, they are Congo, Somalia, Pakistan, and Afghanistan. Most people running away from Boko Haram imbroglio are women and children. About 12 million people are affected of famine in the horn of Africa where women and children are the majority. Half million children are said to be on the brink of starving to death. Every 90 seconds of everyday, a woman dies in pregnancy or due to childbirth-related complications. Girls are still less likely to be in school than boys. One in five women will become a victim of rape or attempted rape in her lifetime. One in four women will become a victim of domestic violence in her life time – many of these on a number of occasions. Women who experience violence are up to three times more likely to acquire HIV. Indeed, it is now among women and children, not the men spreading it, that Aids is most prevalent. It is not just women and girls who pay the price. We all suffer for failing to make the most of Nigeria's talent and potential. We undermine the quality of democracy, the strength of our economies, the health of our societies and the sustainability of peace.

These are the reasons why female political leaders given opportunities to contribute their talents and experiences must perform to add to our national development.

The Need for Good State

It is Aristotle who once said that the supreme good is a life of contemplation. It is a life of supreme happiness or satisfaction. To Aristotle, it is a life of contemplation that brings happiness – not mere pleasure, but well-being, a happy spirit, a pleasant state of mind. Aristotle is right but human happiness cannot be divorced from material and social needs. The State must ensure peace and security. The State for Aristotle comes into being

in order to help humans actualize their potentiality. Human beings require the fellowship and services of other to realize their potentiality as human beings. The Nigerian State must therefore allow all her citizens to actualize their potentialities. I believe that experience of the performance of women saddled with responsibilities has shown that they are more prudent than and not as corrupt as men particularly as domestic and political office holders. Perhaps that is one of the reasons why Paul Kagame the President of Rwanda has more women in his cabinet[6].

Conclusion

Modern civilization has impacted African women positively in education, politics, economics etc. What is need of them is to utilize their potentialities as the State and men would allow them to do so despite some of the challenges I observe above. I have seen that some strategies adopted are working. Women need encouragement to stand up for their rightful place in politics. I believe that treating women both as means and ends is the surest way to enable them contribute more meaningfully to the suitable development of Nigeria. Women can begin to push the 35% representation in all elected or appointed positions in decision-making and public life to 45% and see how they would perform. This is because performance would encourage the next government to bring them in and for women themselves to lobby for each other.

References

1.Olusegun Stephen Taiwo, "Political leadership as panacea to Nigerian Woman Political empowerment", paper presented at the **4th Women in Africa and the African Diaspora (WAAD) International Conference on** Education, Gender & Sustainable Development in the Age of Globalization Abuja, Nigeria, August 3-8, 2009.

2.Lewu Alaba Yetunde in "Nigerian Women in Politics: A Study of the Role of Women in President Obasanjo's Administration, 1999-2003" in Toyin Falola & S.U. Fwatshak, eds., *Beyond Traditions: African Women and Cultural Spaces*, (Ibadan: African World Press, 2010), 338-340.

3.Bernard Eugune Meland, *Faith and culture*, (London: Feffer & Simons, 1953), 120.

4.Gbenoba Ayo Lawal, "Women in Power", Sunday Tribune Magazine, June 30, 2002, 11.

5.http://www.incenigeria.org/index.php?do=publication&id=73&title=2011%20Election20%candidates&cat-id=16, retrieved on 23rd August, 2011.

6.Segun Ogungbemi, "African Women at the receiving end" in Toyin Falola & S.U. Fwatshak, eds., *Beyond Traditions: African Women and Cultural Spaces*, (Ibadan: African World Press, 2010), 13.

Emergence of Fungal Pathogen *Rhodotorula mucilaginosa* and Real-Time PCR Assay for Future Detection

Giek Far Chan

Department of Biological Sciences, Faculty of Biosciences and Bioengineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.
Bionanotechnology Research Group, Sustainability Research Alliance, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.

Sivaranjini Sinniah

Faculty of Biosciences and Bioengineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.
Email: giekfar@utm.my

Abstract

Rhodotorula species have shown significant worldwide prevalence emerged as fungal pathogen, mainly *Rhodotorula mucilaginosa* that causes fungemia. In this study, a molecular assay based on real-time PCR using EvaGreen was developed for sensitive and accurate detection of *R. mucilaginosa*. A pair of primers that specifically target this yeast was designed and the amplification assay was optimized using EvaGreen as the DNA binding dye. The assay could detect and quantify up to 100 fg concentration of genomic DNA from *R. mucilaginosa* with amplification efficiency of 101.8%. The quantitative real-time PCR assay merits future evaluation study in order to evaluate its potential as molecular diagnosis tool for early detection of rare fungal infection caused by *R. mucilaginosa*.

Keywords: Mycosis, red yeast, *Rhodotorula mucilaginosa*, skin infection

Introduction

Rhodotorula mucilaginosa is a basidiomycetous red yeast, belonging to the family *Cryptococcaceae* (Miceli et al., 2011; Moore et al., 1989). The pigmented yeast is an obligate aerobe and contains a high concentration of carotenoid that protects the cells from oxidative damage (Moore et al., 1989). *R. mucilaginosa* was reported to produce esterase (Lee et al., 1987), mannan polysaccharide (Takita et al., 2001), rhodotorulic acid siderophore (Andersen et al., 2003), and carotenoids (Aksu and Eren, 2005). Lately, a marine isolate of *R. mucilaginosa* TJY15a was found to accumulate a large amount of fatty acids from hydrolysate of cassava starch, which could be used for production of biodiesel (Li et al., 2010). *R. mucilaginosa* TJY15a was also reported to produce oil from hydrolysates of inulin and extract of tubers of Jerusalem artichoke (Zhao et al., 2010). Yuce et al. (2010) reported for the first time on the use of lyophilized *R. mucilaginosa* as a biomaterial of modified carbon paste electrode to construct a biosensor for determination of copper. In bioremediation, *R. mucilaginosa* was found to have great potential in biodegradation of nitrobenzene (Zheng et al., 2009) and decolorization of textile dyes (Onat et al., 2010).

In metal removal via bioaccumulation, both live and dead biomass of *R. mucilaginosa* strains was reported to have the potential for uptake of silver dicyanide (Gomes et al., 2002). Besides that, Robiglio et al. (2011) discovered potential of *R. mucilaginosa* as a biocontrol agent. Coupled with *Aureobasidium pullulans*, the two epiphytic could reduce the decay incidence of postharvest pears by *Penicillium expansum* to 33% and the lesion diameter in 88% after 60 days of incubation in cold (Robiglio et al., 2011). Li et al. (2011) also revealed the potential of the yeast against postharvest gray mold, blue mold and natural decay development of apples.

Rhodotorula spp. have been isolated from faeces, nails, skin, sputum, digestive tract and adenoids and regarded as part of normal human floral. However, since 1999, the yeast species have been reported to cause both local and systemic infections (Galan-Sanchez et al., 1999). Infection caused by *Rhodotorula* spp. occurred worldwide, with highest incidence (48.8%, 181 cases) in the Asia-Pacific region (Miceli et al., 2011). From a systematic review of 128 cases carried out by Tuon and Costa (2008), *Rhodotorula* infection caused 79% fungemia (103 cases), 7% eye infections (nine cases) and 5% (six cases) peritonitis associated with continuous ambulatory peritoneal dialysis. The review has also shown that *R. mucilaginosa* as the most common species of fungemia found in 74% of the cases (Tuon and Costa, 2008). *R. mucilaginosa* was also being regarded as a rare source of skin infection. Back in 1970, Beemer and co-workers reported on an epidemic of dermatitis affecting the skin of the back and thighs of chickens. In addition, the isolation of *R. mucilaginosa* from skin lesions in a Southern sea lion (*Otaria flavescens*) was reported for the first time by Alvarez-Perez et al. (2010).

Recently, *R. mucilaginosa* has been regarded as an emerging opportunistic fungal pathogen, especially among immunocompromised patients. In the ARTEMIS surveillance project, *R. mucilaginosa* is the most common cause of *Rhodotorula* species fungaemia, followed by *R. glutinis* and *R. minuta*. *R. mucilaginosa* has also been isolated from cases of fungaemia associated with lymphadenitis from a patient with well-controlled HIV infection (Fung et al., 2009), meningitis and infective endocarditis from patient with acute impairment of the neurological system, hypertensive crisis and renal failure (Loss et al., 2011). The yeast was associated with catheters (Al-Obaid et al., 2011; Tuon et al., 2007; Tuon and Costa, 2008) and prostheses (Savini et al., 2008). Perniola et

al. (2006) reported on an outbreak in the neonatal intensive care unit caused by *R. mucilaginosa* that resulted in signs of sepsis appeared in four premature infants carrying indwelling vascular catheters.

R. mucilaginosa could present a real threat as it is often resistant to fluconazole and voriconazole (Miceli et al., 2011). Amphotericin has been used for treatment of *Rhodotorula* infection (Miceli et al., 2011; Perniola et al., 2006). In the case of lymphadenitis from patient with well-controlled HIV infection, itraconazole therapy for 8 months had successfully resolved lymphadenopathy (Fung et al., 2009). From an *in vitro* susceptibility testing carried out by Gomez-Lopez et al. (2005), amphotericin B and flucytosine exhibited good activity against most the majority of clinical isolates of *Rhodotorula* spp. including *R. mucilaginosa*.

Reliable identification of *R. mucilaginosa* in patient specimens is important for clinical management of fungal infections. In the case of lymphadenitis from patient with well-controlled HIV infection, the diagnosis of *R. mucilaginosa* was established microbiologically by tissue cultures. The yeast could be cultured on Sabouraud-dextrose agar (Fung et al., 2009). Besides that, in the case of persistent catheter-related fungemia, the diagnosis of *R. mucilaginosa* was based on repeated isolation from blood cultures, followed by molecular identification by PCR amplification and sequencing of the ITS region of rDNA. The diagnosis was further supported by detection of *R. mucilaginosa* DNA in consecutive serum specimens (Al-Obaid et al., 2011). To our best knowledge, there is no molecular assay reported for clinical diagnosis of *R. mucilaginosa*. Hence, in this study, we aim to develop a real-time PCR diagnosis assay for detection of *R. mucilaginosa*. The design of novel oligonucleotides, as well as the sensitive quantitative real-time PCR assay for detection of *R. mucilaginosa* is reported here. This molecular assay could result in accurate and sensitive detection of *R. mucilaginosa* that enable rapid diagnosis of infection by this emerging yeast in the future.

Materials and Methods

Yeast culture

A local clinical isolate of *R. mucilaginosa* strain ZH9 was obtained from the Microbiology and Molecular Biology Laboratory Culture Collection (Universiti Teknologi Malaysia, Malaysia). The yeast strain was formerly isolated from a patient with persistent skin infection and identified by 18S rDNA identification (Sinniah, 2012). The yeast was cultured on Sabouraud dextrose agar (SDA) plates and incubated at 30ºC for 48 h prior to isolation of genomic DNA.

Genomic DNA extraction

The yeast cells were scraped from the SDA plate and lysed using liquid nitrogen, followed by extraction using Wizard Genomic DNA Purification Kit (Promega, USA) according to the manufacturer's instruction. The efficiency of DNA extraction was determined using Nanodrop spectrometer (Thermo Scientific, USA) and verified by agarose gel electrophoresis.

Primer design

The PCR primers were designed using Primer-BLAST (Rozenv and Skaletsky, 2000) based on the selected sequences of *R. mucilaginosa* 18S rRNA genes from the GenBank database (http://www.ncbi.nlm.nih.gov/). The 18S rRNA gene sequence of *R.*

mucilaginosa strain ZH9 is available in the GenBank database under accession number JQ838010. The primers were aligned with 18S rDNA sequences of selected *R. mucilaginosa* strains using ClustalW. *S*pecificity check for the designed primers was carried out against human and other fungal sequences available from the non-redundant (nr) database (Altschul et al., 1997).

Development of real-time PCR assay
The reaction mix for DNA amplification consisted of SsoFast^{TM} EvaGreen Supermix (Bio-Rad Laboratories, USA) and 10 pmol of each primer. The reactions were carried out in 0.2-mL tubes containing 19 µL reaction mix and 1 µL of DNA extract. Fast PCR cycling was performed with pre-denaturation at 95°C for 3 min, followed by 40 cycles of denaturation at 95°C for 15 s, annealing at 50°C for 15 s and extention at 72°C for 15 s, with fluorescence acquisition step at the end of the extention step. The setting on the CFX96 system (Bio-Rad Laboratories, USA) and amplification data was managed using CFX Manager 1.6 (Bio-Rad Laboratories, USA). A serial dilution of fungal DNA at different concentrations from 10ng to 10fg was prepared and tested. The assay sensitivity was determined from the detection limit of low target concentrations. Electrophoresis on 1.5% agarose gel was performed to view the amplified PCR products. The expected size of amplified band was 437 bp. The assay specificity was also determined by PCR amplification against genomic DNA from bacterial and fungal species commonly available in the laboratory including *Escherichia coli*, *Bacillus subtilis*, *Citrobacter freundii*, *Candida ethanolica*, *Pichia kudriavzevii*, *Candida parapsilosis*, and *Aureobasidium pullulans*.

Results

Primer design
The conserved regions in 18S rRNA genes among the same species of *R. mucilaginosa* were observed during alignments of the genes downloaded from NCBI database. Besides that, the conserved regions should be specific for *R. mucilaginosa* and showed very low level of similarity with related species within genus of *Rhodotorula*. This resulted in the following sequences: RMfor-1 (5'- CCA ATG GCC TTC GGG TCC -3') and RMrev-1 (5'- GCT GAC AGA GCC CGA AGT TC-3') as forward and reverse primers, respectively. The primers were counter-checked against other sequences available from NCBI database. Figure 1 shows the regions of 18S rRNA gene of *R. mucilaginosa* that would result in amplification of a 437-bp band.

Quantitative PCR assay
Real-time PCR assay for detection of *R. mucilaginosa* was successfully developed and the amplification results are shown in Fig. 2. In Fig. 2a, fluorescence signals were generated by EvaGreen for detection up to 100 fg DNA concentration of *R. mucilaginosa*. The melt curve of the amplicons is shown in Fig. 2b and the melt temperature was detected at 84.5°C. The relationship between the threshold cycle and the initial amount of genomic template DNA concentration was determined and the linear curve is shown in Fig. 3 with $R^2 = 0.9926$. The assay allows sensitive detection and quantification of *R. mucilaginosa* DNA over the range of 100 fg to 10 ng with a PCR efficiency of 101%. The quantitative assay is specific as a single amplified band of 437-bp is shown in the 1.5% agarose gel of Fig. 4. Furthermore, negative amplification results were observed when the molecular assay was tested against other bacterial and fungal species including

Escherichia coli, *Bacillus subtilis*, *Enterobacter cloacae*, *Citrobacter freundii*, *Candida ethanolica*, *Pichia kudriavzevii* and *Aureobasidium pullulans*. From the performance evaluation, the PCR assay was sensitive and specific for detection of *R. mucilaginosa*.

Discussion

The development of a molecular diagnosis assay for detection of superficial fungal infections is important in clinical dermatology (Hay and Jones, 2010). It has been recognized that there is an increase in mycosis due to opportunistic fungal strains. Many opportunistic fungal strains have now emerged as pathogenic strains, which may due to an increased number of immunocompromised patients as a result of HIV infection, cancer treatment and lifestyle diseases. The widespread use of broad-spectrum antibiotics which eliminates the protective natural microflora could also result in the prevalence of fungal infections (Carlson, 2012). As reviewed in the introduction, one of the rare and opportunistic fungal strains that could threaten human well-being is *R. mucilaginosa*.

One of the major challenges in confronting the tropical fungal skin infection is the availability of rapid and accurate diagnosis. Diagnosis of fungal infection depends heavily on the cultural and histological methods (Hay and Jones, 2010). As far as morphological characteristic is concerned, accurate and rapid identification of fungal pathogens remain as a great challenge. In our previous attempt to determine the cause of persistent skin infection, *R. mucilaginosa* was among the fungal strains isolated. In this case, the patient suffered from 12 years of fungal skin infection and was misdiagnosed as having athlete's foot infection (Sinniah, 2012). This shows that accurate and reliable molecular diagnosis is necessary to identify the fungal strains causing the persistent infection in order to allow early administration of correct treatment regime as some *Rhodotorula* species and *R. mucilaginosa* strains are resistant to few antifungal agents (Miceli et al., 2011; Rajmane et al., 2011; Tuon and Costa, 2008). Molecular assay will be a great tool for accurate diagnosis in cases of multiple fungal infections as the morphological characteristics of fungal isolates could be confusing.

Hence, molecular assay based on real-time PCR assay was developed for future detection of *R. mucilaginosa*. Until now, this is the first report on real-time PCR quantitative assay targeting on 18S rRNA gene of *R. mucilaginosa*. Molecular diagnosis focusing on the use of highly conserved 18S sequence of ribosomal gene coupled with the highly varied intervening ITS regions may provide a means to achieve better sensitivity and specificity of fungal infection diagnosis (Hay and Jones, 2010). In this study, it was shown that 18S rRNA gene of *R. mucilaginosa* could be used as a suitable target for successful amplification by quantitative PCR for rapid detection. The assay was efficient as it allowed sensitive detection up to 100 fg of DNA template. The quantitative molecular assay for the fungus reported here will be evaluated in the future with different species of *Rhodotorula* and larger population of clinical samples prior to development of diagnostic kit.

Acknowledgment

References

Aksu, Z. and Eren, A.T. (2005). Carotenoids production by the yeast *Rhodotorula mucilaginosa*: use of agricultural wastes as a carbon source. Process Biochem. 40: 2985-2991. doi:10.1016/j.procbio.2005.01.011

Al-Obaid, I., Khan, Z.U., Ahmad, S., Emara, M., Burhama, M., Purohit, P., and Joseph, L. (2011). Persistent catheter-related *Rhodotorula mucilaginosa* fungemia in a leukemic child. J. Mycol. Med. 21: 134-137. doi:10.1016/j.mycmed.2011.02.001

Alvarez-Perez, S., Mateos, A., Dominguez, L., Martinez-Nevado, E., Blanco, J.L., and Garcia, M.E. (2010). Isolation of *Rhodotorula mucilaginosa* from skin lesions in a Southern sea lion (*Otaria flavescens*): a case report. Vet. Med. 55: 297-301.

Andersen, D., Renshaw, J.C. and Wiebe, M.G. (2003). Rhodotorulic acid production by *Rhodotorula mucilaginosa*. Mycol. Res. 107: 949-956. doi: 10.1017/S0953756203008220

Beemer, A.M., Schneerson-Porat, S. and Kuttin, E.S. (1970). *Rhodotorula mucilaginosa* dermatitis on feathered part of chickens: an epizootic on a poultry farm. Avian Dis. 14: 234-239.

Carlson, B. (2012). As fungal infections expand, so does market. Genet. Eng. Biotechn. 32: 11.

Fung, H.B., Martyn, C.A., Shahidi, A. and Brown, S. T. (2009). *Rhodotorula mucilaginosa* lymphadenitis in an HIV-infected patient. Int. J. Infect. Dis. 13: e27-e29. doi:10.1016/j.ijid.2008.04.006

Galan-Sanchez, F., Garcia-Martos, P., Rodriguez-Ramos, C., Marin-Casanova, P. and Mira-Gutierrez, J. (1999). Microbiological characteristics and susceptibility patterns of strains of *Rhodotorula* isolated from clinical samples. Mycopathologia. 145: 109-112.

Goyal, R., Das, S., Arora, A., and Aggarwal, A. (2008). *Rhodotorula mucilaginosa* as a cause of persistent femoral nonunion. J. Postgrad. Med. 54: 25-27.

Gomes, N.C.M., Rosa, C.A., Pimentel, P.F., Mendonca-Hagler, L.C.S. (2002). Uptake of free and complex silver ions by different strains of *Rhodotorula mucilaginosa*. Braz. J. Microbiol. 33: 62-66.

Gomez-Lopez, A., Mellado, E., Rodriguez-Tudela, J.L. and Cuenca-Estrella, M. (2005). Susceptibility profile of 29 clinical isolates of *Rhodotorula* spp. and literature review. J. Antimicrob. Chemoth. 55: 312-316. doi:10.1093/jac/dki020

Hay, R. J. and Jones, R. M. (2010). New molecular tools in the diagnosis of superficial fungal infections. Clin. Dermatol. 28: 190-196. doi:10.1016/j.clindermatol.2010.01.001

Lee, H., To, R.J.B., Latta, R.K., Biely, P. and Schneider, H. (1987). Some properties of extracellular acetylxylan esterase produced by the yeast *Rhodotorula mucilaginosa*. Appl. Environ. Microbiol. 53: 2831-2834.

Li, M., Liu, G.L., Chi, Z. and Chi, Z-M. (2010). Single cell oil production from hydrolysate of cassava starch by marine-derived yeast *Rhodotorula mucilaginosa* TJY15a. Biomass Bioenerg. 34: 101-107. doi:10.1016/j.biombioe.2009.10.005

Li, R., Zhang, H., Liu, W., and Zheng, X. (2011). Biocontrol of postharvest gray and blue mold decay of apples with *Rhodotorula mucilaginosa* and possible mechanisms of action. Int. J. Food Microbiol. 146: 151-156. doi:10.1016/j.ijfoodmicro.2011.02.015

Loss, S.H., Antonio, A.C.P., Roehrig, C., Castro, P.S., and Maccari, J.G. (2011). Meningitis and infective endocarditis caused by *Rhodotorula mucilaginosa* in an immunocompetent patient. Rev. Bras. Ter. Intensiva. 23: 507-509.

Miceli, M.H., Díaz, J.A. and Lee, S.A. (2011). Emerging opportunistic yeast infections. Lancet Infect. Dis. 11: 142-151.

Moore, M.M., Breedveld, M.W. and Autor, A.P. (1989). The role of carotenoids in preventing oxidative damage in the pigmented yeast, *Rhodotorula mucilaginosa*. Arch. Biochem. Biophys. 270: 419-431.

Onat, T.A., Gumusdere, H.T., Guvenc, G., Donmez, G. and Mehmetoglu, U. (2010). Decolorization of textile azo dyes by ultrasonication and microbial removal. Desalination. 255. 154-158. doi:10.1016/j.desal.2009.12.030

Perniola, R., Faneschi, M.L, Manso, E., Pizzolante, M., Rizzo, A., Sticchi Damiani, A. and Longo, R. (2006). *Rhodotorula mucilaginosa* outbreak in neonatal intensive care unit: microbiological features, clinical presentation, and analysis of related variables. Eur. J. Clin. Microbiol. Infect. Dis. 25: 193-196. doi:10.1007/s10096-006-0114-2

Rajmane, V.S., Rajmane, S.T., and Ghatole, M.P. (2011). *Rhodotorula* species infection in traumatic keratitis - a case report. Diagn. Micr. Infec. Dis. 71: 428-429. doi: 10.1016/j.diagmicrobio.2011.08.009

Robiglio, A., Sosa, M.C., Lutz, M.C., Lopes, C.A., and Sangorrín, M.P. (2011). Yeast biocontrol of fungal spoilage of pears stored at low temperature. Int. J. Food Microbiol. 147: 211-216. doi:10.1016/j.ijfoodmicro.2011.04.007

Savini, V., Sozio, F., Catavitello, C., Talia, M., Manna, A., Febbo, F., Balbinot, A., Bonaventura, G.D., Piccolomini, R., Parruti, G. and D'Antonio, D. (2008).

Femoral prosthesis infection by *Rhodotorula mucilaginosa*. J. Clin. Microbiol. 46: 3544-3555. doi:10.1128/JCM.00873-08

Sinniah, S. (2012). Molecular identification of multiple rare fungal pathogens causing persistent foot skin infection. Dissertation Universiti Teknologi Malaysia.

Takita, J., Katohda, S. and Sugiyama, H. (2001). Structural determination of an exocellular mannan from *Rhodotorula mucilaginosa* YR-2 using ab initio assignment of proton and carbon NMR spectra. Carbohyd. Res. 335: 133-139.

Tuon, F.F. and Costa, S.F. (2008). *Rhodotorula* infection. A systematic review of 128 cases from literature. Rev. Iberoam Micol. 25: 135-140.

Tuon, F.F., de Almeida, G.M., and Costa, S.F. (2007). Central venous catheter-associated fungemia due to *Rhodotorula* spp. - a systematic review. Med. Mycol. 45: 441-447.

Yuce, M., Nazir, H. and Donmez, G. (2010). A voltammetric *Rhodotorula mucilaginosa* modified microbial biosensor for Cu(II) determination. Bioelectrochemistry. 79: 66-70. doi:10.1016/j.bioelechem.2009.11.003

Zhao, C-H., Zhang, T., Li, M. and Chi, Z-M. (2010). Single cell oil production from hydrolysates of inulin and extract of tubers of Jerusalem artichoke by *Rhodotorula mucilaginosa* TJY15a. Process Biochem. 45: 1121-1126. doi:10.1016/j.procbio.2010.04.002

Zheng, C., Zhou, J., Wang, J., Qu, B., Wang, J., Lu, H. and Zhao, H. (2009). Aerobic degradation of nitrobenzene by immobilization of *Rhodotorula mucilaginosa* in polyurethane foam. J. Hazard. Mater. 168: 298-303. doi:10.1016/j.jhazmat.2009.02.029
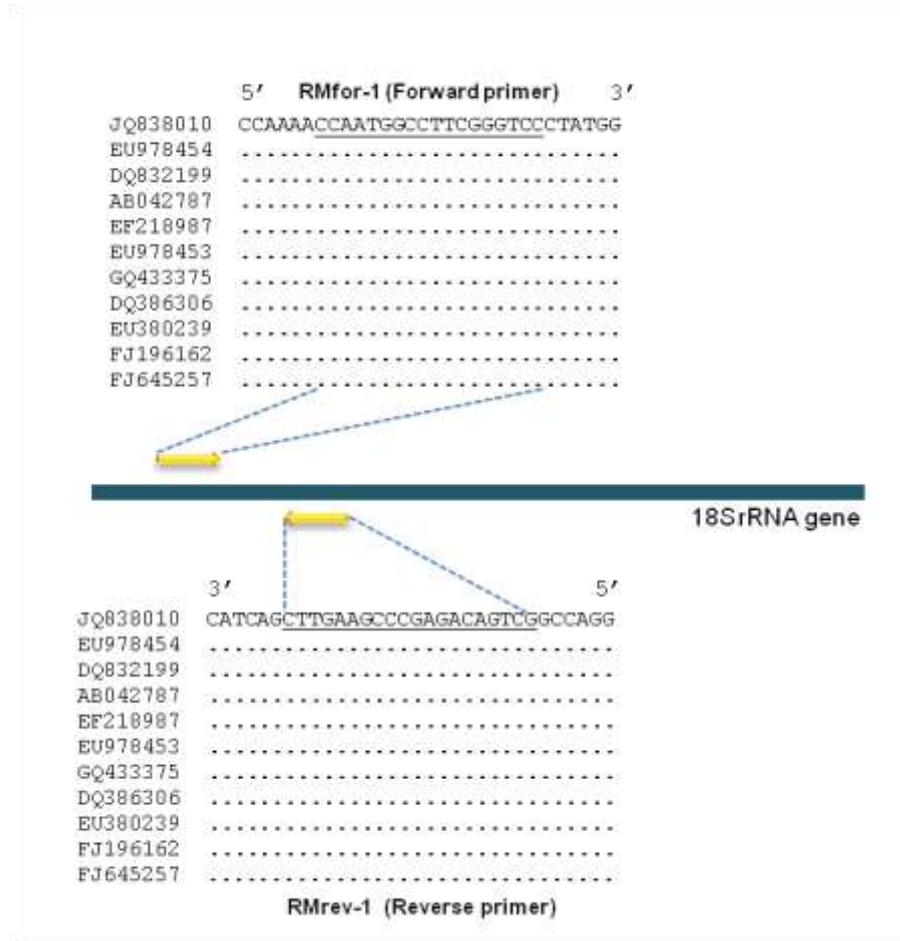
Appendix

Fig. 1 Schematic diagram of oligonucleotides obtained from18S rRNA gene of *R. mucilaginosa*. Multiple alignment with ten other sequences of *R. mucilaginosa* strains available from NCBI database (indicated by GenBank accession numbers) was shown.
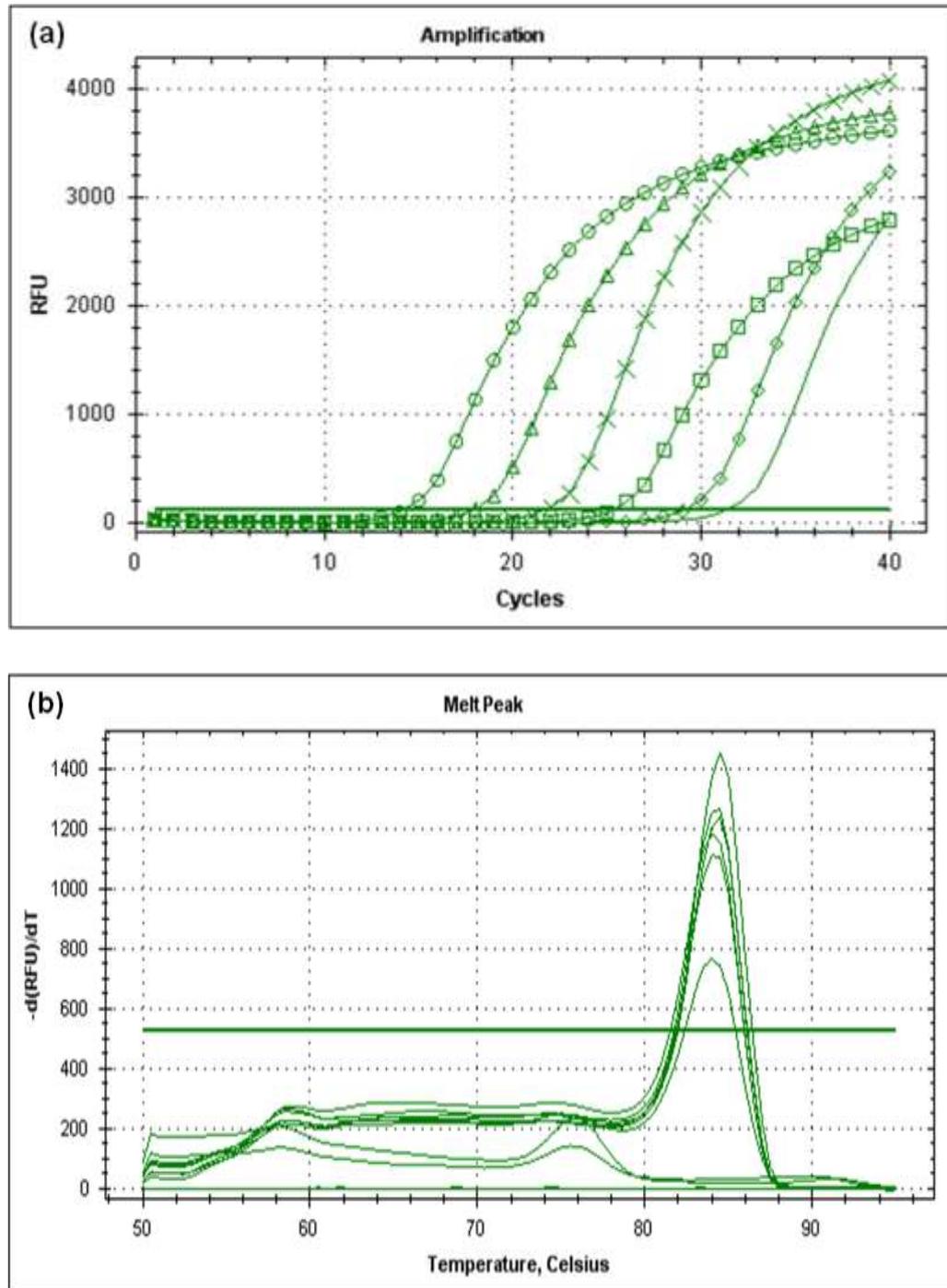
Fig. 2 (a) Sensitivity of quantitative real-time PCR assay using EvaGreen detection dye with a series of 10-fold dilutions of *R. mucilaginosa* genomic DNA. The DNA concentrations that showed distinct fluorescence signals were 10 ng (○), 1 ng (Δ), 100 pg (×), 10 pg (□), 1 pg (◊) and 100 fg (-). RFU: Relative fluorescence unit. Distinct fluorescence signals were generated for concentration up to 100 fg of *R. mucilaginosa* DNA. (b) Verification of the melt peak generated from the reactions. The melt temperature for the target amplicon was 84.5ºC.
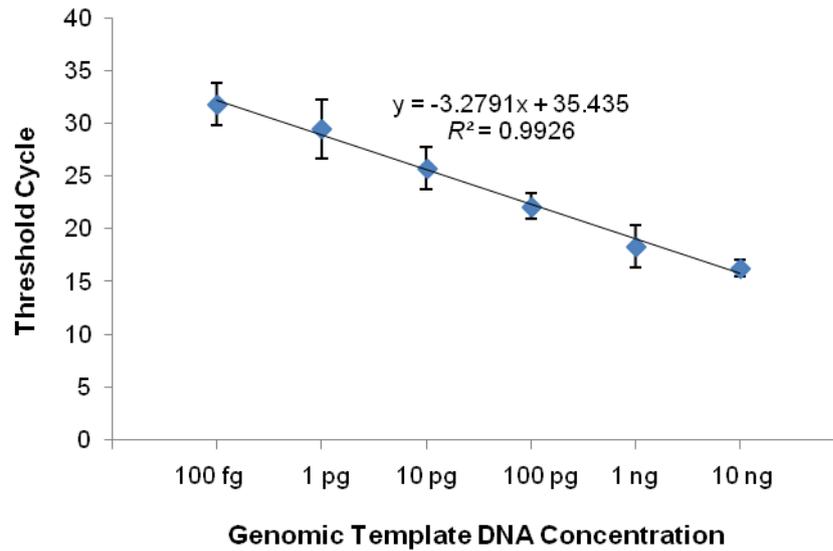
Fig. 3 Relation between the threshold cycle and the initial amount of *R. mucilaginosa* DNA detected using EvaGreen real-time PCR assay. The PCR amplification efficiency is 101.8%. Values are means ± standard deviation of triplicates.
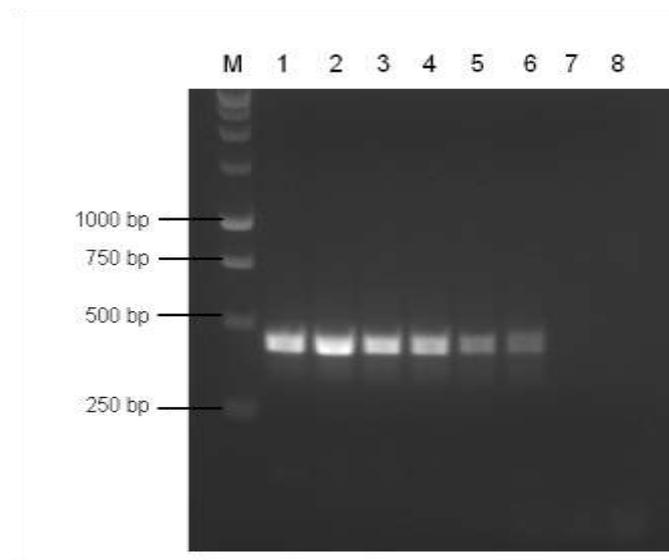

Fig. 4 Agarose gel electrophoresis to verify the presence of specific amplicon after real-time PCR. M: 1 kb DNA Ladder (Promega). Lanes 1 to 6 show the targeted amplicon detected from amplification of genomic template at initial concentrations of 10 ng, 1 ng, 100 pg, 10 pg, 1 pg, and 100 fg. There is no amplicon detected at both lanes 7 and 8, which were amplification reaction done using 10 fg of genomic template and deionized water as negative control.