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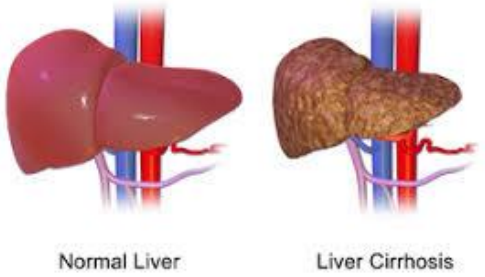
Volume 8 (6); November 25, 2018

Research Paper

Acetylation Phenotype Impact on Early Postoperative Period in Viral Liver Cirrhosis.

Ibadov RA, Omonov OA, and Ibragimov SKh.
J. Life Sci. Biomed., 8(6): 90-93, 2018;
pii:S225199391800014-8



Abstract
Objective. The aim of our study was to identify some pathogenetic mechanisms and unify prediction factors for the development of complications after portosystemic shunting. Material and Methods: The present research involved 45 patients with liver cirrhosis complicated by portal hypertension. Buccal swabs and spot urine samples were used to determine acetylation phenotypes. The genotype of each individual was determined by polymerase chain reaction. High-performance liquid chromatography was used to determine acetylation phenotypes. Results: Rapid acetylation was revealed in 7 patients (15.6%) and slow acetylation was found in 38 patients (84.4%). In slow acetylation phenotype, a considerable progression of liver cirrhosis was observed in comparison with rapid acetylators alanin aminotransferaz (ALT) on 74.4 % in slow acetylation phenotype (SAcP) against 29.5% in rapid acetylation phenotype (RAcP); total bilirubin on 111.8% in comparison with 42 %, respectively; the level of ammonia in blood was 247.8% compared to 62.5%). Recommendation: Taking into consideration the acetylation phenotype of liver cirrhosis patients can help in predicting possible side-effects and evaluate efficiency of drugs that are metabolized by N-acetylation.

Keywords: Acetylation Phenotype, Viral Liver Cirrhosis, Portal Hypertension, Central Portosystemic Shunting, Postoperative Period
[Full text-PDF] [XML]

Research Paper

Water Hyacinth (Eichhornia crassipes) Biology and its Impacts on Ecosystem, Biodiversity, Economy and Human Well-being.

Degaga AH.
J. Life Sci. Biomed., 8(6): 94-100, 2018;
pii:S225199391800015-8

Abstract
The aim of this review article was to show water hyacinth biology, chemical composition and its negative impacts on aquatic ecosystem, biodiversity, economy and human wellbeing. Water hyacinth is challenging the ecological stability of freshwater bodies. It is native to the Amazon Basin in Brazil and other nearby South American countries. In Africa, the first introduction of water hyacinth was in Egypt in 1880. In Ethiopia, water hyacinth was officially reported in 1956 in Koka Lake and the Awash River. Nutrients and temperature are considered the strongest determinants for water hyacinth growth and reproduction. Under favorable conditions, water hyacinths can double its mass every 5 days and it also grows from seed, which can remain viable for 20 years. Due to its extremely fast growth, the weed has become the major floating water weed of tropical and subtropical regions. In the absence of natural enemies, the weed quickly becomes invasive, colonizing slow moving waters resulting in thick and extensive mats which degrade aquatic ecosystems and limit their utilization. These mats affect fisheries and related commercial activities, functioning of irrigation canals, navigation, hydroelectric programmes and tourism. Its 95% mass weight is water from 5% dry matter 50% is silica and 30% is K, 15% N and 5% protein. The spread of this invasive plant is difficult to manage and not easy to reverse. Its impact is not only loss of biodiversity in aquatic ecosystems but also economic development and human wellbeing. It supports as breeding ground for vectors and pests. Hand removal is most effective for small infestations while mechanical harvesting can be an effective tool for removing larger infestations. The best method to control water hyacinth is to prevent it from entering a water body. This can be through education programs that have proved to be an effective tool in preventing further spread into catchments by people for ornamental purposes. So Ethiopian Government has to declare water hyacinth and other invasive species as a national pest and then put legislation in place to control them.

Keywords: Aquatic Ecosystem, Aquatic Weed, Invasive Plant Species, Fast Growth, Mat Formation
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Acetylation Phenotype Impact on Early Postoperative Period in Viral Liver Cirrhosis

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ABSTRACT

Objective. The aim of our study was to identify some pathogenetic mechanisms and unify prediction factors for the development of complications after portosystemic shunting. Material and Methods: The present research involved 45 patients with liver cirrhosis complicated by portal hypertension. Buccal swabs and spot urine samples were used to determine acetylation phenotypes. The genotype of each individual was determined by polymerase chain reaction. High-performance liquid chromatography was used to determine acetylation phenotypes. Results: Rapid acetylation was revealed in 7 patients (15.6%) and slow acetylation was found in 38 patients (84.4%). In slow acetylation phenotype, a considerable progression of liver cirrhosis was observed in comparison with rapid acetylators alanin aminotransferaz (ALT) on 74.4 % in slow acetylation phenotype (SAcP) against 29.5 % in rapid acetylation phenotype (RAcP); total bilirubin on 111.8 % in comparison with 42%, respectively; the level of ammonia in blood was 247.8% compared to 62.5%). Recommendation: Taking into consideration the acetylation phenotype of liver cirrhosis patients can help in predicting possible side-effects and evaluate efficiency of drugs that are metabolized by N-acetylation.

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Acetylation Phenotype,
Viral Liver Cirrhosis,
Portal Hypertension,
Central Portosystemic Shunting,
Postoperative Period

INTRODUCTION

Management of patients with liver cirrhosis complicated with portal hypertension after central portosystemic shunting. Hence, studying of acetylation polymorphism is currently relevant not only because many medical products are metabolized by acetylation reactions but also owing to better understanding the molecular basis of acetylation. These genetically caused metabolism variations of pharmaceuticals explain specific features of pharmacologic and therapeutic effect of drugs. Two genes found in humans are known to be responsible for activity of N-acetyl transferase. Recent research has shown that some alleles of these genes influence individual susceptibility to some diseases.

One of urgent problems in current pathologic physiology is studying the mechanisms of a disorder of detoxification functions of the liver in patients with various forms of liver pathology [1]. The hepatic endoplasmic network contains a family of isoenzymes of cytochrome P450 that is specific to various substrata. The processes of acetylation play an important part in interstitial metabolism. At present, acetylation phenotypes are considered to be a genetically determined ability of the body to metabolize compounds containing amino groups [2].

All pharmaceuticals pass the specific pharmacokinetic pathway by virtue of certain enzymes controlled genetically. Wide polymorphism in humans suggests that the fate of a pharmaceutical at any pharmacokinetic stage is associated with the polymorphic system of an enzyme or protein. It also causes diverse reactions of individuals to medicines [3].

To neutralize toxic products of metabolism or toxic substances in tissues some adaptable mechanisms, including those arranged in the toxigenic-kinetic, humoral, immunologic, and metabolic systems responsible for maintaining homeostasis in the body, have been developed in the course of evolution. Among them, the oxygen-dependent enzymes of the monooxygenase system play the important role [2]. Genetic differences in regulation, expression and activity of the genes, that code production of enzymes during the first and second

phases of xenobiotic biotransformation, can become a key factor of susceptibility to toxic effect of xenobiotics and development of a pathological process in the liver [4, 5].

Recently modern approaches of personalized medicine have been developed, e.g. assessment of the gene activity on the basis of studying the matrix RNA and drug metabolism [4]. Pharmacologic and kinetic research of pharmaceuticals is being conducted in many countries to evaluate the modes of drug dosing, considering individual variability of phenotypes of genetically determined biotransformation systems [5]. These studies will help not only to select the optimum doses of pharmaceuticals but to predict possible complications of the primary disease as well.

The aim of study was to identify some pathogenetic mechanisms and unify prediction factors for the development of complications after portosystemic shunting.

MATERIAL AND METHODS

Ethical approval

The review board and ethics committee of RSSPMCS named after acad. V.Vakhidov approved the study protocol and informed consents were taken from all the participants.

The results of examination of 45 patients with viral liver cirrhosis complicated by portal hypertension (PH) have been analyzed. Morphological examination revealed large-nodule liver cirrhosis (LNLC) in over half of them (26 patients; 57.8%); 19 patients (42.2 %) had small-nodule liver cirrhosis (SNLC). In 39 patients, cirrhotic transformations of the liver were caused by viral hepatitis B, and in 6 patients it developed after viral hepatitis C. At the time of examination, antibodies to HCV were found in all 6 patients, and 39 patients had positive HBs-Ag. The patients were examined before and after central portosystemic shunting (PSS) with spleen preservation and after selective distal splenic-renal anastomosis (DSRA). The clinical course after the surgery was severe in 3 (6.7 %) patients, rather satisfactory in 5 (11.1 %) and uneventful in 37 (82.2 %) patients.

In addition to standard tests, the examination included evaluation of the level of reopirin metabolites, namely 4-amino-antipirin (4AAP) and N-acetyl-4-amino-antipirina (N-ac-4AAP) in urine. The latter method is specific because 4-AAP discharged with urine is a direct product of N- demethylation performed with microsomal monooxygenase system, while N-ac-4AAP is a product of further acetylation. The acetylating ability of the body was assessed by the method of Prebsting-Gavrilova modified by Anilova and Tolkachevsky. It was interpreted as slow if it did not reach 50%, and rapid when it made 50 % and more.

Before the surgery, a considerable decrease in excretion of reopirin metabolites was observed in all patients under study. For instance, in the SNLC patients, the level of 4 AAP in daily urine specimen was 3.6 times below the controls, and the level of the same metabolites in the LNLC patients was 7.36 times lower. The SNLC patients had 3-times lower N-ac-4AAP level, and that one in LNLC patients was 5.74 times lower. Rapid acetylation was revealed in 7 (15.6 %) patients, while slow acetylation was found in 38 patients (84.4 %).

RESULTS AND DISCUSSION

According to our findings, slow acetylation prevailed in patients with morphological variants of liver cirrhosis. For instance, the slow acetylation phenotype (SAcP) was found in 38 of 45 liver cirrhosis patients (84.4 %), while 7 (15.6 %) patients had the rapid acetylation phenotype (RAcP).

The comparative analysis of the basic blood biochemical parameters of patients with various types of acetylation made before and during the postoperative period has shown that an increase in the basic biochemical indicators of the liver did not depend on the type of acetylation. However, the values of these indicators were different in the compared groups. For instance, if a cytolytic component manifested itself as an increase in the levels of ALT and aspartate aminotransferase (AST) in blood of the patients before the surgery was almost identical in both groups, the postoperative indicator in the group of patients with RAcP was a little lower, than in the ones with SAcP.

The basic biochemical tests of blood before and after the postoperative period in patients with various morphological forms of cirrhosis demonstrated aggravation of these indicators depending on the liver cirrhosis form. As Figure 1 shows, a more favorable liver cirrhosis course in patients with rapid acetylation is obvious. For instance, if the ALT level increased from 212.7±46.5 nmol\l to 383.4±127.2 nmol\l in slow acetylation (i.e. a gain made 74.4 %), in the rapid type, the gain appeared to be considerably smaller: 29.5 % ($P < 0.05$). After surgery the total bilirubin level in the blood of patients with SAcP increased from 25.4±6.7 to 53.8±19.7 mcmol/l that

made 111.8 %, while in the group with RAcP, hyperbilirubinemia was less expressed: before the surgery it was 23.1±4.2 32.8±8.1 mcmol/l or 42 % (P <0.01) and after it.

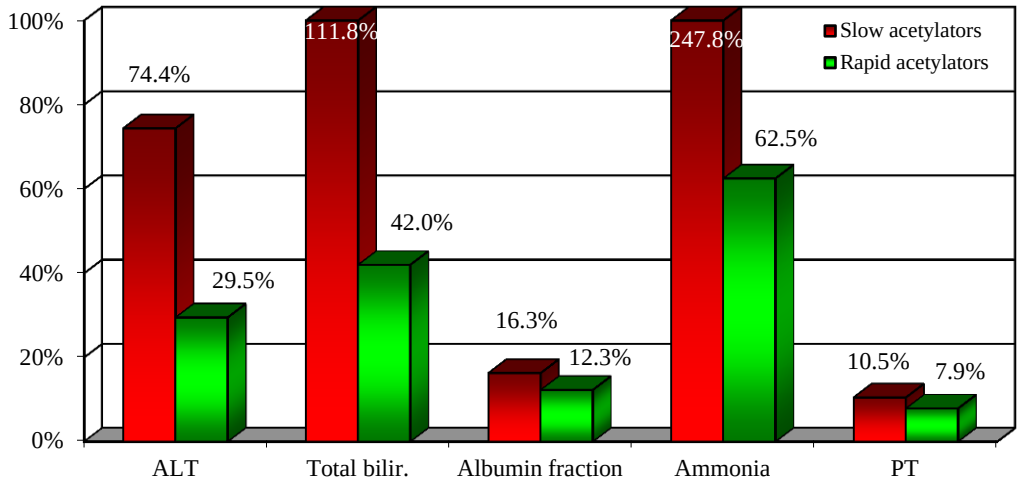

Figure 1. Progression of the basic biochemical indicators of blood depending on the acetylation type in early postoperative period

When analyzing the total protein levels, it was revealed that in the patients with slow acetylation, the albumin fraction before the surgery had been 39.2±2.9 g/L, while in the early postoperative period it had decreased to 32.8±3.9 g/L. The ammonia level in the blood of patients with cirrhosis is rather demonstrative. The indicator before the surgery and in early postoperative periods again demonstrates the advantage of rapid acetylation. For instance, in the patients with slow acetylation, the ammonia level increased by 247.8 %, while in the patients with the rapid one, it increased by 62.5 % (P<0.01).

The prothrombin time (PT) values before and after the surgery also differed, although to a lesser degree. In slow acetylation, PT decreased from 84.2±6.8 to 75.4±9.8, (i.e. by 10.5 %), and in the rapid type, a decrease appeared to be considerably smaller: 7.9 % (P <0.5).

Figure 2 presents the list and frequency of specific postoperative complications in the patients with different types of acetylation. The number of complications in patients with SAsP was observed to exceed the average incidence and specific complications developed more often than in rapid acetylators. Portosystemic encephalopathy was diagnosed in 6 patients and hepatic coma developed in 1 patient with SAcP, while in RAcP, only one patent had portosystemic encephalopathy of grades 1-2. Cholestasis was not observed in rapid acetylators, while in slow ones, it was observed in 2 cases. Edema and ascites developed in 7 patients with SAcP.

The correlation and comparative analysis demonstrated that parenhymatous-vascular decompensation in liver is characterized by: hepatic encephalopathy and mesenchimal and inflammatory response was observed in 36.8 % of patients with SAsP whereas in RAsP this complication developed only in one patient (14.3 %). No hemorrhage was observed in RAsP; in SAsP, it was found in 7.9 % of cases.

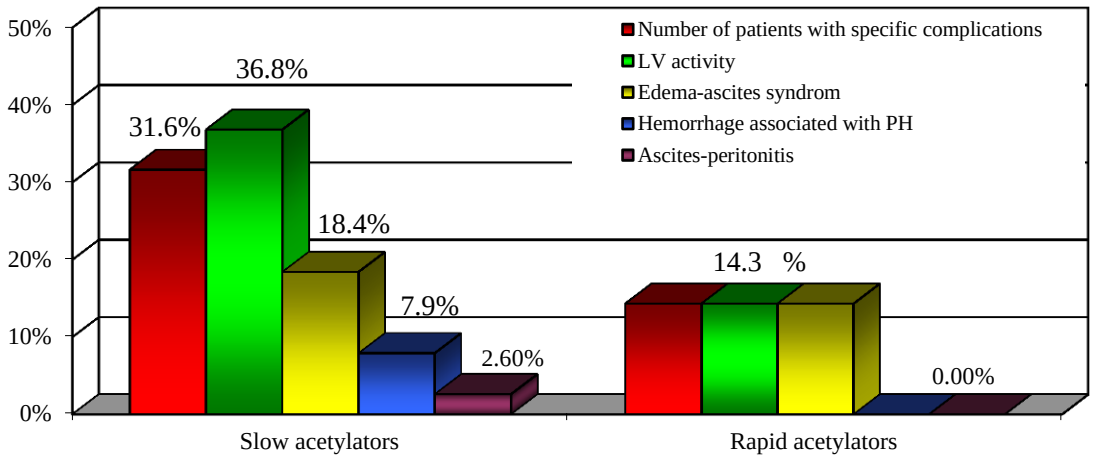

Figure 2. Progression of main biochemical indicators depending on the acetylation type

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CONCLUSION

Slow acetylation phenotype mainly develops in liver cirrhosis patients (84.4 %), it being characterized by more often specific and nonspecific complications in the postoperative period irrespectively of the morphological form of cirrhosis. In slow acetylation, considerable liver cirrhotic progression in comparison with rapid acetylators was observed (ALT on 74.4 % in SAcP, against 29.5 % in RAcP, total bilirubin on 111.8 % compared to 42 %, the level of ammonia in blood was 247.8 % against 62.5 %, etc.).

Therefore, acetylation phenotypes of all patients with liver cirrhosis should be determined in the preoperative period since those ones with slow acetylation are at risk of possible specific and nonspecific complications in the postoperative period. Taking into consideration the acetylation phenotype of liver cirrhosis patients can help in predicting possible side-effects and evaluate efficiency of drugs that are metabolized by N-acetylation.

DECLARATIONS

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Authors' Contributions
All authors contributed equally to this work.

Competing interests
The authors declare that they have no competing interests.

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Water Hyacinth (*Eichhornia crassipes*) Biology and its Impacts on Ecosystem, Biodiversity, Economy and Human Well-being

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ABSTRACT

The aim of this review article was to show water hyacinth biology, chemical composition and its negative impacts on aquatic ecosystem, biodiversity, economy and human wellbeing. Water hyacinth is challenging the ecological stability of freshwater bodies. It is native to the Amazon Basin in Brazil and other nearby South American countries. In Africa, the first introduction of water hyacinth was in Egypt in 1880. In Ethiopia, water hyacinth was officially reported in 1956 in Koka Lake and the Awash River. Nutrients and temperature are considered the strongest determinants for water hyacinth growth and reproduction. Under favorable conditions, water hyacinths can double its mass every 5 days and it also grows from seed, which can remain viable for 20 years. Due to its extremely fast growth, the weed has become the major floating water weed of tropical and subtropical regions. In the absence of natural enemies, the weed quickly becomes invasive, colonizing slow moving waters resulting in thick and extensive mats which degrade aquatic ecosystems and limit their utilization. These mats affect fisheries and related commercial activities, functioning of irrigation canals, navigation, hydroelectric programmes and tourism. Its 95% mass weight is water from 5% dry matter 50% is silica and 30% is K, 15% N and 5% protein. The spread of this invasive plant is difficult to manage and not easy to reverse. Its impact is not only loss of biodiversity in aquatic ecosystems but also economic development and human wellbeing. It supports as breeding ground for vectors and pests. Hand removal is most effective for small infestations while mechanical harvesting can be an effective tool for removing larger infestations. The best method to control water hyacinth is to prevent it from entering a water body. This can be through education programs that have proved to be an effective tool in preventing further spread into catchments by people for ornamental purposes. So Ethiopian Government has to declare water hyacinth and other invasive species as a national pest and then put legislation in place to control them.

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Aquatic Weed,
Invasive Plant Species,
Fast Growth,
Mat Formation

INTRODUCTION

The spread of invasive species is difficult to manage and not easy to reverse, this threatens not only biodiversity of aquatic ecosystems but also economic development and human wellbeing [1]. Water hyacinth (*Eichhornia crassipes*) is an invasive aquatic plant associated with a variety of ecological and economic effects on freshwater ecosystems [2]. It is a free-floating aquatic plant that grows in ponds or slow moving waterways. It is a perennial monocotyledonous crop that belongs to the Pontederiaceae family. It is native to the Amazon Basin in Brazil and other nearby South American countries [3]. And Holm, *et al.*, [4] reported that, *E. crassipes*, a native of South America, is a major freshwater weed in most of the frost-free regions of the world and is generally regarded as the most troublesome aquatic plant. It is considered the worst aquatic weed in the world [5]. In Africa, the first introduction of water hyacinth was in Egypt in 1880 [6]; the main aquatic weed in East Africa is Water hyacinth [5]. In Ethiopia, water hyacinth was officially reported in 1965 in Koka Lake and the Awash River [7, 8] and infestation of Lake Tana was officially recognized in 2011 [9]. It has been recognized as the most damaging aquatic weed in Ethiopia since 1965 [8]. In Lake Tana in addition to water hyacinth, other two floating invasive weeds: Azolla and Water Lettuce, were reported [10].

Water hyacinth reproduces both sexually and asexually. The rapid increase and spread of the plant into new areas is due particularly to its vegetative reproduction, a single plant being able to develop very rapidly a significant infestation [11]. Water hyacinth has a rapid propagation and morphological characteristics that makes the weed well adapted to rapid distance dispersal and successful colonization of varying habitats in a

short time [12]. Moving easily with water currents, winds or other accidental means, such as fishing nets and boats, the plant invaded rivers, canals, ponds, lakes, dams and other freshwater bodies. In the absence of natural enemies, the weed quickly becomes invasive, colonizing slow moving waters resulting in thick and extensive mats [13] which degrade aquatic ecosystems and limit their utilization [14]. The negative impacts of water hyacinth are due to its dense, impenetrable mats which restrict access to water. These mats affect fisheries and related commercial activities, functioning of irrigation canals, navigation/transport, hydroelectric programmes and tourism [15].

Nutrients and temperature are considered the strongest determinants for water hyacinth growth and reproduction [17]. Salinity constraints generally limit water hyacinth establishment in coastal areas and within estuaries [17]. Due to its extremely fast growth, the weed has become the major floating water weed of tropical and subtropical regions. There for the aim of this review was to show water hyacinth biology, chemical composition and its negative impacts on aquatic ecosystem biodiversity, economy and human wellbeing. And to show water hyacinth is challenging the ecological stability of freshwater ecosystems.

Biology, chemical composition and ecology of water hyacinth

The *E. crassipes* growth is extremely rapid and forms large populations of inter-connected shoots which is impenetrable mat. It forms dense, interlocking mats due to its rapid reproductive rate and complex root structure [18]. The flowers are bluish purple, large and self-fertile. The seeds are produced in large numbers and are contained in capsules, each capsule containing up to 300 seeds [19]. The seeds can remain viable for 5-20 years [20]. The plant can also reproduce vegetative through the production of horizontal stolons. Rakotoarisoa, *et al.*, [11] described that due to its high reproduction rate, the complex root structure and the formation of dense mats with up to two million plants per hectare can be found. Under favorable conditions, water hyacinth can double its mass every 5 days and it also grows from seed, which can remain viable for 20 years or longer [21, 22]. The biotic seeds dispersals are birds thought to be transported over long distances (e.g. waterfowl and shore birds) and if coated in mud they may cling to both mammals and birds [23, 24]. While, wind is the abiotic dispersal, it will readily move the plant and the upright leaves in lakes and canals. Along rivers, water flow is the prime mover of vegetative material but strong winds may sometimes blow the plant upstream.

Water hyacinth draws all its nutrients directly from water. It absorbs heavy metals [25], organic contaminants [26], and nutrients from the water column [27]. It comprises 95% water and 5% dry matter of which 50% is silica, 30% Potassium, 15% Nitrogen and 5% protein [28]. While Roger and Davis [29] reported that the uptake of nitrogen by water hyacinth is 5 to 10 times as rapidly as phosphorous. It has been known to thrive well in nutrient-enriched fresh waters in tropical climatic zones. For this purpose it has been used in wastewater treatment facilities [30].

The structure of a macrophyte assemblage plays a large role in determining composition of phytoplankton, zooplankton, fish, and birds in freshwater ecosystems [31]. A shift in the primary-production base of a lake can resonate throughout the ecosystem, affecting multiple trophic levels both directly through changes in habitat availability and indirectly through shifts in energy pathways. Free floating plants are able to monopolize light and absorb nutrients from the water column, preventing phytoplankton and submersed vegetation from obtaining sufficient resources for photosynthesis [32]. Altering ecosystem services and processes, reducing native species abundance and richness, and decreasing genetic diversity of ecosystems [33] and also water hyacinth affects diversity, distribution and abundance of life in aquatic environments [34].

Water hyacinth impacts on biodiversity loss

Water hyacinth is challenging the ecological stability of freshwater bodies [35], out-competing all other species growing in the vicinity, posing a threat to aquatic biodiversity [22]. Besides suppressing the growth of native plants and negatively affecting microbes, water hyacinth prevents the growth and abundance of phytoplankton under large mats, ultimately affecting fisheries [36]. This is because fish feed on phytoplankton. According to the Millennium Ecosystem Assessment [37], freshwater ecosystems are among the most significantly human-altered systems in the world. While invasive species are considered the leading threat to global aquatic biodiversity [38].

Most water hyacinth effects are lower phytoplankton productivity and dissolved oxygen concentrations beneath mats [39, 40]. Reduced phytoplankton productivity can decrease zooplankton abundance by decreasing food availability [19, 41]. It also affects diversity, distribution and abundance of life in aquatic environments and enhances evapo-transpiration, thus affecting all aquatic organisms. The death and decay of water hyacinth

vegetation in large masses create anaerobic conditions and production of lethal gases [34]. Coverage of water hyacinth causes de-oxygenation of water, and at times anoxia below the dense mats [42]. Water quality effects include higher sedimentation rates within the plant's complex root structure and higher evapo-transpiration rates from water hyacinth leaves when compared to evaporation rates from open water [43]. A shift in the primary-production base of a lake can resonate throughout the ecosystem, affecting multiple trophic levels both directly through changes in habitat availability and indirectly through shifts in energy pathways [44]. Dissolved oxygen less than 5 mg per litter are known to adversely affect function and survival of most fishes and less than 2 mg per litter can lead to fish kills [45]. This low level of dissolved oxygen along the water column will happen when large water hyacinth mats prevent light infiltration or when a relatively large area of plants decompose at the same time.

In the 1950s, within three years of its first sighting, it had spread 1600 km along the Congo River [24]; in Lake Tana in 2012 after a year of infestation officially recognized its estimation coverage was 20,000 hectares [46]. This shows that if once introduced to favorable habitats, especially open waters, *E. crassipes* may spread very rapidly and can form dense monotypic mats. Which is impenetrable and blocking access both for transportation and aquatic living organisms in addition to adding to much organic matter to water bodies leading anoxia condition. The introduction and spread of non-native species contribute to the loss of aquatic species [47].

Economic impacts of water hyacinth

Because of its rapid growth and mat formation, *E. crassipes* has a range of detrimental effects on the economy sector. The dense mats disrupt socioeconomic and subsistence activities for example ship and boat navigation, restricted access to water for recreation, fisheries, and tourism [22, 48]. It physically interferes with water transport, communication and access. Infestations are increasing in Ethiopia, creating a range of problems including restricted access [49]. In Nigeria, Alimi and Akinyemiju [50] showed that costs of fuel and repairs to boats on infested waterways was approximately three times that on un-infested waterways. Economic losses also result from interference with recreational uses of water bodies [43, 49]. Heavy infestations by Water Hyacinth make fishing very difficult, or impossible [5]. Fishermen are being troubled by a reduced range of fish species, loss of nets and impeded access [51]. Water hyacinth was perceived to affect fisheries through reduced levels of production, a reduction in species diversity, poor quality fish, rising cost of operation resulting in lower income to fishers and higher prices to consumers [52].

In Lake Victoria mats blocked breeding, nursery, and feeding grounds for economically important fish species, such as tilapia and Nile perch. Because water hyacinth mats can reduce natural predation and fisheries catchability, leading to increased abundance of certain species [53]; but mats can also exclude certain species from important breeding, nursery, and feeding grounds [54]. Expensive barriers or mechanical damage to hydro-electric installations and other structures such as bridges; for example, to the Owen Falls Dam on Lake Victoria [55], there are also similar concerns in South Africa [56], and Ethiopia [27].

Figure 1. Shore of Lake Tana (a) Cattle grazing and water hyacinth (b) Hippopotamus select grass but do not graze water hyacinth [10]

Water hyacinth has limited beneficial uses. Local communities around Lake Tana, they are worried about the invasion of their shore farm and grazing lands and cattle grazing the water hyacinth when there is no grass [10]. It cannot be used as a livestock feed because it contains too much silica, calcium oxalate, potassium and too little protein [30]. Therefore, this leads reducing grazing potential, have a negative impacts on animal health, milk and meat quality (Figure 1) and economical reduction on the livestock sector of the country. Dereje, *et al.*, [34] mentioned that expansion of water hyacinth around Lake Tana and its competition with the native species

the submerging grasses and other native species becomes devastated. These affect a lot of cattle which are directly and indirectly dependent on the grass. And also shore area floras which would be important for fish breeding grounds and livestock forage source in the vicinity become damaged.

Water hyacinth impacts on human wellbeing

E. crassipes may reduce water quality in various ways and encourage mosquitoes, snails and other organisms associated with human illnesses, including malaria, schistosomiasis, encephalitis, filariasis and cholera [43, 56] It also increased health hazards i.e. incidence of malaria and schistosomiasis [15]. FAO [5] also described that, this weed represents an environmental problem as well and indirectly a public health problem, since it may create a microhabitat suitable for the breeding of many vectors of human diseases and for hosting poisonous snakes. The infestation of water hyacinths (*Eichhornia crassipes*) in African lakes has increased breeding site availability for malaria vector species, *An. funestus* complex were reported from a water hyacinth mat [57]. Malaria vectors are able to breed amongst water hyacinth mats in Lake Victoria [58].

Water hyacinth control methods

Water hyacinth is extremely difficult to eradicate once established, the goal of most management efforts is to minimize economic costs and ecological change [44] The optimum control method depends on the specific conditions of each affected location such as the extent of water hyacinth infestation, regional climate, and proximity to human and wildlife [36]. Hand removal is most effective for small infestations such as small dams and drains. It is highly laborious and should only be used where the rate of removal can exceed the rate of re-growth. It should be done before flowering and seed set in spring [1]. Mechanical shredding of water hyacinth is cheaper than harvesting [59], but there are significant consequences of allowing the plant to die and decompose within the system. Understanding the density threshold at which water hyacinth starts to impact ecosystems, society, and local economies will help management establishment goals for population control that can maximize the social benefits while minimizing the costs of the invasive species [44]. Therefore, the best method to control water hyacinth is to prevent it from entering a water body.

Biological control is most effective on larger infestations but it can take several years for it to provide successful control. It involves the use of natural enemies including plant pathogens [36, 60]. The aim of any biological control is not to eradicate the weed, but to reduce its abundance to a level where it is no longer problematic. While there exists several native enemies of water hyacinth, two South American weevil beetles (*Neochetina eichhorniae* and *Neochetina bruchi*) and two water hyacinth moth species (*Niphograpta albiguttalis* and *Xubida infusella*) have had effective long-term control of water hyacinth in many countries, notably at Lake Chivero [28], Lake Victoria (Kenya), Louisiana (USA), Mexico, Papua New Guinea and Benin [35, 60, 61, 62]. Researchers have identified another tiny insect, *Megamelus scutellaris*, from South America which is highly host-specific to water hyacinth and does not pose a threat to native or economically important species [63].

CONCLUSION AND RECCOMENDATION

Biological alien invasions are a major driver of biodiversity loss worldwide. Water hyacinth (*Eichhornia crassipes*) is common and widely distributed all over the world, is challenging the ecological stability of freshwater ecosystems. The spread of invasive alien species is neither easy to manage nor easy to reverse. They are threatening not only biodiversity but also economic development and human wellbeing. Threats are destruction of biodiversity; oxygen depletion and reduced water quality; breeding ground for pests and vectors; blockage of waterways hampering agriculture, fisheries, recreation and hydropower; fishing, grazing and other agricultural activities by forming impenetrable thickets and hindering movements of humans and animals, and destroying and replacing natural biodiversity. Proliferation of water hyacinth is a symptom of broader watershed management and pollution problems.

The best method to control water hyacinth is to prevent it from entering a water body. Development of national and local policies for the detection, control and eradication of invasive species within and around aquatic ecosystems, farm lands, communal lands and in all ecosystems is required to prevent impacts of invasive species ahead not only on biodiversity loss but also, ecosystem and economy of a country. Therefore, the recommendation based on this review is that Ethiopian Government has to declare water hyacinth and other invasive species as a national pest and then put legislation in place to control them. Since Ethiopia being a member of Convention on Biological Diversity (CBD) which urges the parties to "prevent the introduction of,

control, or eradicate those alien species which threaten ecosystem, habitat or species"; the impact of invasive weeds on environment, article 8(h) of the CBD signed by 161 countries at the Earth Summit [64] .

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Competing interests

The author declare that there is no any competing interests.

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2. Karen KS, Otto CM. 2007. Pregnancy in women with valvular heart disease. Heart. 2007 May; 93(5): 552–558. DOI, Link
3. Doll MA, Salazar-González RA, Bodduluri S, Hein DW. Arylamine N-acetyltransferase 2 genotype-dependent N-acetylation of isoniazid in cryopreserved human hepatocytes. Acta Pharm Sin B, 2017; 7(4):517-522. DOI, Link

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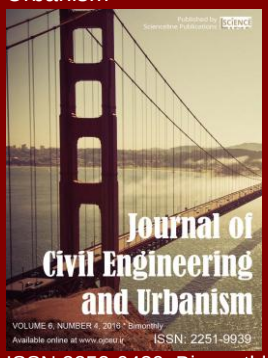

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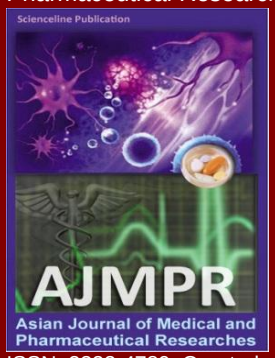

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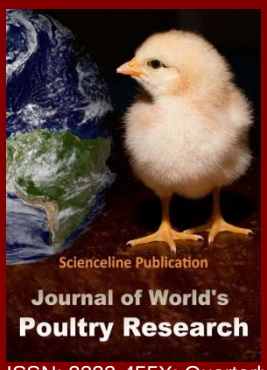

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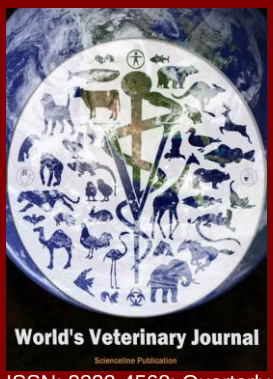

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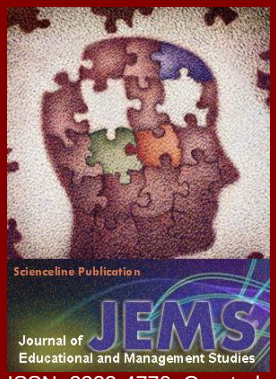

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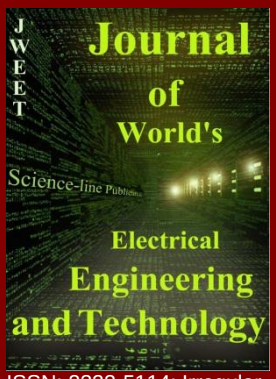

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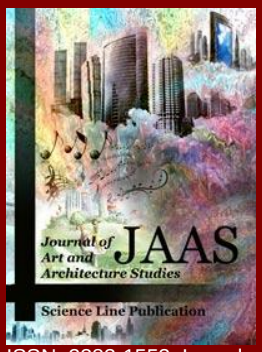

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