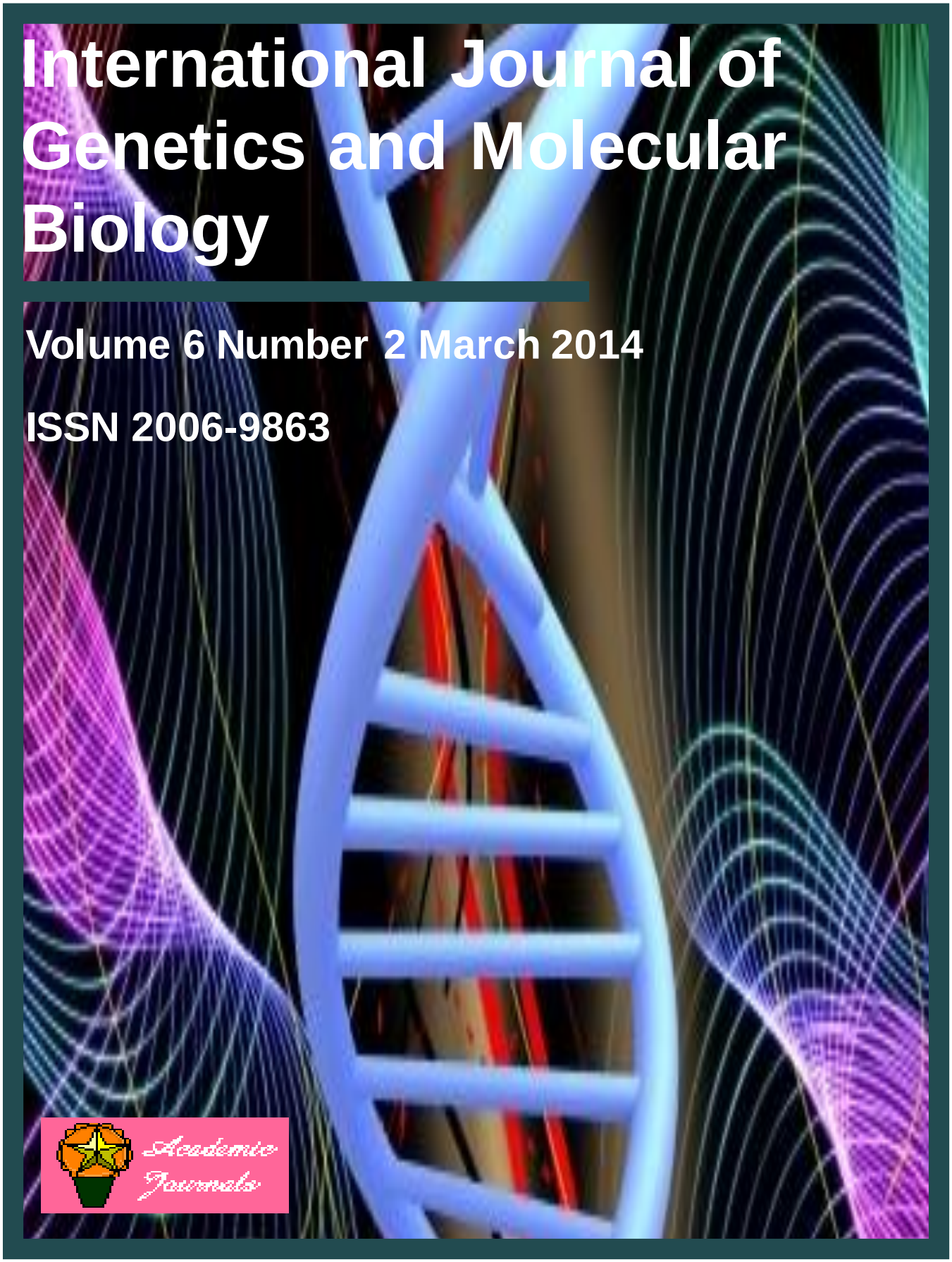

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Review

Challenges in conserving and utilizing plant genetic resources (PGR)

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The problems of food and income security are of global significance and are further compounded by precedential increase in world population resulting in overexploitation of natural resources and by extension plant genetic diversity. Plant genetic resources (PGR) refer to the heritable materials contained within and among plant species of present and potential value. In the recent past, genetic diversity found in landrace, weedy and wild cultivars have been reported to savage animal and plant population diseases, pest and environmental changes. Nevertheless, these resources are lost at alarming rates due to anthropogenic product and by products such as climate change, pollution, genetic erosion, gross mismanagement of these resources and population growth. Hence, the need for conservation and sustainable utilization of these resources. PGR conservation is the management of varietal diversity in plant occasioned by interaction between genes and the environment for actual or potential and present or future use. A complimentary application of *in situ* and *ex situ* conservation technique is recommended for their effective conservation. Efficient survey, collection and documentation is also pertinent. International, national and individual appreciation of the value of this vast genetic diversity would facilitate their sustainable utilization. PGR utilization refers to the use value of these genetic resources. There is need to create avenues through which these can be easily accessed and enact effective policies for their protection especially in their hotspot and regions of high endemism.

Key words: Plant genetic resources (PGR), conservation, utilization, environmental changes, population growth, genetic erosion.

INTRODUCTION

Plant genetic resources (PGR) is the pillar upon which world food security and agriculture depends especially with expanding global population. PGR refers to the heritable materials contained within and among plant species of present and potential, economic, scientific or societal value. They include materials considered of systematic importance and applicable in cytogenetic, phylogenetic, evolutionary biology, physiological, biochemical, pathological and ecological research and breeding; encompassing all cultivated crops and those of little to no agricultural value as well as their weedy and wild relatives (Ulukan, 2011). Hammer and Teklu (2008) opined that the genetic adaptation and the rate of evolutionary response of a species to selective forces (changing environments, new pests and diseases and new climatic conditions) depend on inherent levels of

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genetic diversity present at the time. The importance of PGR is reflected in every facet of human endeavor as it provides the gene pool from which resistant and improved varieties can be engineered. The economic value of increasing crop productivity through the diffusion of improved, modern varieties has been extensively documented, particularly in the context of industrialized agriculture by Alston et al. (2000) and Evenson and Gollin (2003). Costs and benefits for plant genetic resources conserved in gene banks, destined principally for use by commercial farmers have also been estimated by Koo et al. (2004) and Smale and Koo (2003). Thus, PGR can play roles in ensuring income security especially for developing and under developed countries where majority of livelihood is hinged upon these natural resources.

In the past, plant genetic diversity loss was largely caused by natural processes, mainly as a result of climate changes and is still occurring although at a very minimal rate. By contrast, the recent acceleration in the loss of plant diversity is mainly due to the activities of the earth's dominant species. Land clearing, overgrazing, the cutting and burning of forests, the indiscriminate use of fertilizers and pesticides, war and civil strife have all impacted negatively to destroyed natural habitats and the diversity contained therein. Sodhi and Erhlich (2010) supported this by stating that earth dominant species have destroyed, degraded and polluted earth's natural habitat which are key in life support. More so, serious illnesses, water contamination and ecological destruction can be attributed to the drilling of oil which has caused widespread destruction of rainforest and endangered the lives of tens of thousands of people (Hvalkoff, 2001). The diversity of genes within species increases its ability to adapt to adverse environmental conditions. When these varieties or populations of these species are destroyed, the genetic diversity within the species is diminished. In many cases, habitat destruction has narrowed the genetic variability of species lowering the ability to adapt to changed environmental conditions. The greater the variability of the species, the more is the ecosystem stability.

This report is aimed at creating awareness on the threats to PGR and the need for their effective conservation and sustainable utilization.

THREATS TO PGR CONSERVATION AND UTILIZATION

The impact of humans upon biological diversity (biodiversity) has gradually increased with growing industrialization, technology, population, production and consumption rates. Food sovereignty, accessibility and security, landscapes and environmental integrity along with gross mismanagement are contending issues which impact on PGR. Since the era of green revolution, Industrial agriculture and increasing globalization of markets, tastes and cultures, much of this wealth is being lost both on-farm and in genebanks, as increasingly the integrity of these resources is being compromised by genetically modified organisms.

This is further compounded by issues arising from patent rights. The world faces major challenges of population growth, climate change, increasing social and economic instability and a continuing failure to achieve food and income security.

Population growth and Urbanization

As human population break new grounds machinery are set up that modifies the natural environment to his thirst resulting in a strangling pressure on land and other natural resources for food, industries, shelter and agriculture; ultimately leading to habitat destruction and loss of plant genetic resources. For example, Malik and Singh (2006) estimated that the food grain demands by the year of 2020 is anticipated to be around 250 million tonnes, which means an extra 72 million tonnes of food grains are required. This could lead to over exploitation of PGR as witnessed during the Green Revolution. Social disruptions or wars and poverty also pose a constant threat to genetic wipeout as it is associated with heavy reliance directly on natural resource which often leads to overexploitation and destruction of wild PGR.

Pollution

Soil and atmospheric biodiversity including microbial diversity and the diversity of pollinators and predators are also under threat of pollution. Threats to these resources include pollution by genetically modified material and the increasing use of intellectual property rights (IPRs) to claim sole ownership over varieties, breeds and genes, which restricts access for farmers and other food producers. This loss of diversity is accelerating and sliding down the slippery slope of food insecurity that today sends more than 1.2 billion people to bed, hungry.

Habitat loss and modification

Exploration and extraction of natural resources affect and alter the geophysical environment of the areas where they are carried on. An example is the environmental impact of oil exploitation in the Niger Delta region of Nigeria which contribute in no small measure to the destruction of the fragile ecosystem, thus making the region 'one of the world's most severely petroleum impacted ecosystems and one of the five most petroleum-polluted environments in the world' (Niger Delta Natural Resource Damage Assessment and

Restoration Project, 2006). With the exploration of oil; spillage, deforestation, noise pollution and other ecological effects, they are not willing to yield to their demands for adequate attention to their polluted and depreciating environment (Olubisi and Oluduro, 2012).

Climate change

Climate change is having a significant negative impact on the environment and on PGR often leading to perturbations such as drought, flood and disease. Changes in rainfall patterns and extreme weather events are likely to diminish crop yields in many areas. Mores so, rise in sea level, causing loss of coastal land and saline water intrusion, also leads to crop depletion (Pisupati and Warner, 2003). This will impact on the distribution of PGR and most likely alter their physiognomy.

Diseases

The effects of human activities have introduced certain levels of stress to natural resources including PGR. This stress will overtime weaken the immunity of the affected population. More so, PGR are now susceptible to different new diseases absent in the original population. Reduction in gene pool increases vulnerability. Control of fungal diseases by chemicals is expensive and can have negative impacts on natural eco-systems whereas genetically based resistance offers efficient and ecologically sound control (Bhullar et al., 2012).

Alien invasive species (IAS)

IAS are also commonly referred to as invasives, aliens, exotics or nonindigenous species. IAS are species, native to one area or region, that have been introduced into an area outside their natural distribution, either by accident or on purpose, and which have colonized or invaded their new home, threatening biological diversity, ecosystems and habitats, and human well-being. The threat posed to biodiversity by IAS is considered second only to that of habitat loss (CBD, 2005). On small islands, it is now comparable with habitat loss as the lead cause of biodiversity loss (Baillie et al., 2004). Invasive species may out-compete native species, repressing or excluding them and, therefore, fundamentally change the ecosystem. They may indirectly transform the structure and species composition of the ecosystem by changing the way in which nutrients are cycled through the ecosystem (McNeely et al., 2001). Entire ecosystems may be placed at risk through knock-on effects. Given the critical role biodiversity places in the maintenance of essential ecosystem functions, IAS may cause changes in environmental services, such as flood control and water supply, water assimilation, nutrient recycling, conservation and regeneration of soils. Although not all alien species will become invasive or threaten the environment there is need for a clear policy approach because of its potentially wide-ranging impacts when they do become invasive, and because of the difficulties, including financial costs, in reversing its impacts. Virtually all countries in the world are affected at different degrees by IAS. In 2004, IUCN - the World Conservation Union identified 81 IAS in South Africa, 49 in Mauritius, 44 in Swaziland, 37 in Algeria and Madagascar, 35 in Kenya, 28 in Egypt, 26 in Ghana and Zimbabwe, and 22 in Ethiopia (IUCN/SSC/ISSG, 2004).

Patent rights for the protection of plant varieties

Patents are the strongest form of intellectual property (IP) protection in the sense that they normally allow the right holder to exert the greatest control over the use of patented material by limiting the rights of farmers to sell, or reuse seed they have grown, or other breeders to use. Although there is an imbalance between the IP rights afforded to breeders of modern plant varieties and the rights of farmers who were responsible for supplying the plant genetic resources from which such varieties were mainly derived. Patents on plant varieties are only allowed in the US, Japan and Australia. The number of patents relating to rice issued annually in the US has risen from less than 100 in 1995 to over 600 in 2000. The assignment of IPRs to living things is of relatively recent origin in developed countries. The protection of plant varieties (through plant breeder's rights- PBRs), became widespread in the second half of the 20th Century. Thus systems for the protection of plants derive from the economic structure and circumstances of agriculture prevailed in developed countries in this period. All these are challenges because they consider plant not for what they are but for the value that can be derived thereof. More than 90% of crop varieties have been lost from farmers' fields in the past century due to artificial selection.

Replacement of Traditional varieties with modern ones

In recent years, there has been a loss of traditional conservation practices and other customs. This has been mainly because of the expansion of the use of high yielding species and varieties in commercial agriculture, climatic factors, pests and diseases, inappropriate agrarian policies and development activities and poverty, which increase the migration of indigenous youth (with their knowledge, experience and customs of traditional Andean agriculture). The single most important reason

for genetic erosion is the replacement of traditional varieties with modern, high yielding, and genetically uniform ones (Rosendal, 1995). Although gene banks play essential role in conserving and maintaining the varieties, FAO (1998) however reported that widespread genetic erosion is also taking place in some, perhaps even many, genebanks, as a result of poor management, poor maintenance, and scarce financial resources, as well as limited institutional capacities. Based on their mixed experience of the Green Revolution, the farmers were sceptical of GM crops. Contamination by GM maize imported from the USA has been found in a wide area of Oaxaca and Puebla states in Mexico on a large scale. The revealing factor is the presence of the cauliflower mosaic virus, which is used widely in GM crops as a promoter to "switch on" insecticidal properties of genes which have been inserted into them. Monsanto, Syngenta and Aventis all use the same technology. Farmers and consumers are unwilling victims of this pollution. Most importantly local races of crops may well become contaminated through cross-pollination, mixed seed stock, illegal imports of GM seed or contaminated food aid grain being unwittingly used as seed. The Biosafety Protocol should be especially vigilant on releases of GM seeds in Centers of Crop Diversity.

Genetic vulnerability and erosion

Genetic vulnerability results when a widely planted crop is uniformly susceptible to a pest, pathogen or environmental hazard as a result of its genetic constitution, with a potential for widespread crop losses. This phenomena continues to be a significant threat in certain crops and countries (for example hybrid rice in China based on a single male sterile source). A significant example of the impact of genetic vulnerability is the outbreak and continued spread of the Ug99 race of wheat stem rust, to which the large majority of existing varieties is susceptible (Pretorius et al., 2000). Creating and maintaining diversity of crops and their varieties in production systems can help to reduce vulnerability and can be said to impact on ecosystem stability. Manioc - originating in South America - is a major food source for more than 200 million people in 31 African countries. According to Prada (2009), the genetic improvement of crop plants relies on the cultivation of genotypes that possess favourable alleles/genes controlling desirable agronomic trait. This process reduces the levels of genetic diversity. As most of the modern genotypes cultivated today have descended from a relatively small number of landraces, the genes controlling important traits have reduced diversity as compared to the gene pool of landraces and wild relatives (Bhullar et al., 2012).

CONSERVATION OF PLANT GENETIC RESOURCES

It has become increasingly clear during the last few decades that meeting the food needs of the world's growing population depends, to a large extent, on the conservation and sustainable utilization of the world's remaining plant genetic resources. Conservation of plant genetic resources is the process that actively retains the diversity of the gene pool with a view of actual or potential utilization. Utilization is the human exploitation of that genetic diversity. The aim of conservation is to collect and preserve adaptive gene complexes for present or future use (Hammer and Teklu, 2008). The conservation and use of genetic resources is as old as agriculture itself. For over 12,000 years farmers have conserved seed for future planting, domesticated wild plants, and selected and bred varieties to suit their specific needs and conditions. Over the millennia, hundreds of different plant species have been domesticated and within each species, human and natural selection have combined to produce thousands of different varieties. The conservation of genetic resources enables breeders to find the raw materials needed to develop new varieties and farmers to modify their crops in response to changing environments and markets.

The two main conservation strategies are *ex situ* and *in situ*, and each includes a range of different techniques. The products of conservation activities are primarily conserved germplasm, live and dried plants, cultures and conservation data. To ensure safety, conservation products should be duplicated more than one location (Hammer and Teklu, 2008).

Ex-situ conservation

Ex-situ conservation is defined as the conservation of components of biological diversity outside their natural habitat. This includes field gene banks, tissue culture, green house, cryopreservation, seed gene banks, etc. *ex situ* conservation allows the reintroduction of crops in areas where they have been lost through environmental degradation, replacement or war and the stored materials are readily accessible, can be well documented, characterized and evaluated, and are relatively safe from external threats.

Among the various *ex situ* conservation methods, seed storage is the most convenient for long-term conservation of plant genetic resources. This involves desiccation of seeds to low moisture contents and storage at low temperatures (Hammer and Teklu, 2008). For vegetatively propagated and recalcitrant seed species (seed that quickly lose viability and do not survive desiccation), living plants can be stored in field gene banks and/or botanical gardens. Botanical gardens are recommended for the reproduction of rare species. It guarantees freedom from pest infestation and diseases. However, it is extremely labor and cost intensive. Besides, only a limited amount of genetic variation that can be stored and it is vulnerable to natural and human disasters. Biotechnology has generated new opportunities for gene-

tic resources conservation.

Techniques like *in vitro* culture and cryopreservation have made it possible to collect and conserve genetic resources, especially of species that are difficult to conserve as seeds. Cryo-conservation (storage in extreme deep freeze situations) allows for extremely long storage of many species and is accomplished with liquid nitrogen at -196°C. Nonetheless, it is really expensive to maintain and a constant supply of liquid nitrogen has to be available at all times. DNA and pollen storage also contribute to *ex situ* conservation.

In-situ conservation

In situ involves the setting aside and management of natural reserves, where the species are allowed to remain in their ecosystems within a natural or properly managed ecological continuum. This method of conservation is of significance to the wild relatives of crop plants and a number of other crops, especially tree crops and forest species where there are limitations on the effectiveness of *ex situ* methods of conservation (Hammer and Teklu, 2008). It enables species to be conserved under conditions that allow them to continue to evolve.

In situ conservation comprises two main concepts and/or techniques, which may be distinguished as “genetic reserve conservation” and “on-farm conservation.” Both involve the maintenance of genetic diversity in the locations where it is encountered, but the former primarily deal with wild species in natural habitats/-ecosystems and the latter with domesticated species in traditional farming systems. The location, management and monitoring of genetic diversity in natural wild populations within defined areas designated for active, long-term conservation is known as genetic reserve conservation. An example of this technique is the establishment and management of forest reserves especially areas of high species diversity.

On-farm conservation is the sustainable management of genetic diversity of locally developed crop varieties (land races), with associated wild and weedy species or forms, by farmers within traditional agricultural, horticultural or agricultural systems and farmer play a major role in this technique through their selection of plant material which influences the evolutionary process and through their decisions to continue with a certain landrace or not. Plant populations on farms have the capacity to support a greater number of rare alleles and different genotypes. The main drawback is the difficulty in characterizing and evaluating the crop's genetic resources and susceptibility to hazards such as extreme weather conditions, pests and disease. For a successful implementation of on-farm conservation, a better understanding of both crop populations on the farming systems that produce them is needed to create active cooperation between farmers and conservationists. To adequately conserve the full range of genetic diversity of a target species or gene pool, an application of a range of *ex situ* and *in situ* techniques applied in a complementary manner is recommended (Hammer and Teklu, 2008).

SUSTAINABLE UTILIZATION OF PGR

Plant genetic resources are conserved for use by people as food, medicine, fuel, fodder and building materials. According to Hammer and Teklu (2008), conservation without use has little point; conversely, use without conservation means neglecting the genetic base needed by farmers and breeders alike to increase productivity in the future.

Over the last few decades, awareness of the rich diversity of exotic or wild germplasm has increased. This has lead to a more intensive use of this germplasm in breeding and thereby yields of many crops increased dramatically. Domesticated tomato plants are commonly bred with wild tomatoes of a different species to introduce improved resistance to pathogens, nematodes and fungi. Resistance to at least 32 major tomato diseases has been discovered in wild relatives of the cultivated tomato.

To be of use, material held in genebanks must be well documented. This entails maintaining: passport data, giving location, site characteristics, species, cultivar name, characterization data, recording highly heritable characteristics that can be used as a basis to distinguish one accession from another; and evaluation of data, giving traits such as yield, quality, phenology, growth habit and reactions to pest, disease and abiotic stresses. Access to information is becoming increasingly important and information systems which improve access to data are now been made available. For example The International Crop Information System (ICIS) is a data management model and computer based information system developed by CIMMYT.

Networking is another important way of widening the use of plant genetic resources in which priorities are established and tasks shared. Networks bring together all those with an interest in crop genetic resources, whether it is germplasm collectors, curators, researchers, breeders or other users, and provide a means for identifying the genetic resources within a genepool and for taking collective action to conserve and use them.

Over 150 countries are involved in some form of genetic resources networking, and many of the networks themselves have become world-wide fora for sharing resources, ideas, technologies and information (Hammer and Teklu, 2008). They have become an efficient mechanism for enabling countries to share the responsibilities and costs of training, conservation and technology development, and to promote the establishment of joint conservation strategies based on common interests and goals.

RECOMMENDATION AND CONCLUSION

Future development in the improvement of crops largely hinge on immediate conservation of genetic resources for their effective and sustainable utilization. A vast amount of plant genetic resources are threated, endangered and some have even gone extinct and it is more prominent in recent times, mostly due to genetic erosion and environmental transformation by anthropogenic effect.

In other to meet current global challenges all countries and institution must as a matter of primary obligation discover, collect and conserve valuable and potentially valuable plant genetic resource and utilize it sustainably. To this end the following recommendation are of maximum importance for efficient conservation of PGR:

1. An understanding of the extent and distribution of diversity in species and ecosystems is pertinent and this can be achieved through efficient survey, inventory, appropriate research, field studies and analysis.
2. Sustainable agriculture should be promoted through diversification of crop production and development and commercialization of under-utilized crops and species.
3. On-farm management and improvement of plant genetic resources should be supported and this will require integrated approaches combining the best of traditional knowledge and modern technologies.
4. More natural reserved areas should be created and those existing should be properly managed, financially supported and an effective enforcement of laws should guard them.
5. It is important that this diversity be made more useful and valuable to breeders, farmers, and indigenous and local communities, by providing better and more accessible documentation.
6. The best method of conservation is the use of complementary approach of the different *ex situ* and *in situ* conservation techniques. Since part of the worldwide *ex situ* collections is endangered, priority should be placed on securing and providing financial support for existing collections.
7. Means are needed to identify, increase and share fairly and equitably the benefits derived from the conservation and sustainable use of plant genetic resources.
8. Access to and the sharing of both genetic resources and technologies are essential for meeting world food security and needs of the growing world population, and must be facilitated. Such access to and sharing of technologies with developing countries should be provided and/or facilitated under fair and most favourable terms, including concessional and preferential terms, as mutually agreed to by all parties to the transaction. In the case of technology subject to patents and other intellectual property rights, access and transfer of technology should be provided in terms which recognize and are consistent with the adequate and effective protection of intellectual property rights.
9. A comprehensive information retrieval systems for plant genetic resources need to be constructed and development of monitoring and early warning systems for loss of plant genetic resources would be a plus.
10. Public awareness of the value of plant genetic resources through training, seminar and the media should be promoted. Also an integration of conservation priorities into the educational curricula is encouraged.

The value of PGR to human survival cannot be overemphasized and its conservation and sustainable is within our reach. The challenge is now in our cult to preserve these limited resources and secure the future generation.

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Full Length Research Paper

Heliclobacter pylori associated chronic gastritis: Endoscopic and pathological findings, comparative study

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Helicobacter pylori **have been established as a major etiologic factor in the pathogenesis of chronic gastritis, peptic ulcer disease and in the development of gastric adenocarcinoma and gastric mucosa-associated lymphoid tissue lymphoma. This study was conducted on 100 patients. All underwent upper endoscopy, and antral and corpus, and duodenal biopsies were taken. Findings of endoscopic gastritis were observed in 83 patients (p <0.001). Histologically mononuclear inflammatory cellular infiltrates were seen in 95 cases, majority of them showed grade 1 gastritis (64), whereas grade 2 and grade 3 gastritis found in 16 and 15 biopsies. The relationship between endoscopic and histological findings was significant (p <0.001).** ***H. pylori*** **colonization was found in the majority of the biopsies (92) (p <0.001). This study concluded that accurate endoscopic and histopathological examination of gastritis according to the Sydney grading system is valuable indicator of** ***H. pylori*** **infection. Endoscopical abnormalities suggesting gastritis were significantly correlated with the histopathologic findings. Finally, chronic active gastritis with lymphoid follicles was significantly correlated with** ***H. pylori*** **infection (p <0.001).**

Key words: Chronic gastritis, *Helicobacter pylori*, endoscopic and histological grading.

INTRODUCTION

Helicobacter pylori (H. pylori) infection has been established as a major cause of chronic gastritis, which affects approximately 50% of the world's population, and is important in the pathogenesis of other gastro-intestinal diseases as peptic ulcer disease (PUD), gastric adeno-carcinoma and gastric lymphoma (Rotimi et al., 2000; Rugge et al., 2011; Sokwala et al., 2012). Studies reported that the prevalence ranges from less than 15% in some populations to virtually 100%, depending on socio-economic status and country development (Malaty, 2007; Carrasco and Corvalan, 2013).

National Institute of Health Consensus Development Conference (1994) concluded that infected patients with *H. pylori* should receive antimicrobial therapy, as the risk of ulcer recurrence and associated complications do not diminish unless *H. pylori* infection is cured (Versalovic, 2003). Chronic inflammation plays an important role in the development of various cancers, particularly in

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digestive organs, including *H. pylori*-associated gastric cancer (GC) (Uemura et al., 2001). In the same view GC is an important leading cause of cancer-related death particularly in Europe, so understanding the pathogenesis of *H. pylori*-induced GC may improve risk stratification for prevention and therapy (Parkin et al., 2005; Wen and Moss, 2009). In addition to the above, *H. pylori* is well recognized as a class 1 carcinogen because its long-term colonization can provoke chronic inflammation and mucosal atrophy, which can further lead to malignant transformation (Lee et al., 2012).

Assessing gastritis involves clinical examination, endoscopic and histopathological examination (Rugge, 2007; Lauwers et al., 2010). Sydney grading system of chronic gastritis and its updated Houston version (1996) is the commonly-used nomenclature for gastritis and still remains inconsistent. Sydney system categorized gastritis according to intensity of mononuclear inflammatory cellular infiltrates, polymorph activity, atrophy, intestinal metaplasia and *H. pylori* density into mild, moderate and severe categories (Dixon et al., 1996; Dixon et al., 1997). Non-standard histology reporting formats are still widely used for gastritis and even specialists are often frustrated by histological definitions that make it difficult to identify candidates for clinico/endoscopic surveillance (Rugge et al., 2011). Additionally, there is no simple validated test to quantify the density of *H. pylori* infection (Tummala et al., 2004). The aim of this work was to compare between endoscopic and pathological findings of *H. pylori* gastritis and to provide an unequivocal information about grading of gastritis according to the 1996 Sydney grading system.

MATERIALS AND METHODS

Patient selection

During 12-months period (August 2012 to July 2013), 100 patients were selected from all the patients that were seen in the surgery outpatient clinic; Arar Central Hospital, KSA and who were suffering from symptomatic dyspepsia. The patients were examined clinically, and various routine laboratory investigations were done including complete blood count (CBC), liver and renal function tests, and bleeding and coagulation assessment. Then the patients underwent for upper gastro-intestinal endoscopy. Patients were excluded if they had taken *H. pylori* eradication treatment as antibiotics, proton pump inhibitors or H2 antagonists in the 4 weeks before endoscopy.

Endoscopy

It was done under general anesthesia and 2 gastric (one from the gastric antrum, and one from the body), and one duodenal biopsies were obtained. At the same time the patients were examined for presence / absence of findings suggestive of endoscopic gastritis as erythema / hyperemia, atrophy, and mucosal nodularity according to the criteria of Sydney system (Dixon et al., 1996). Additionally, the patients were examined for presence or absence of gastric erosions and findings suggestive duodenitis as hyperemia or ulceration according to Garg et al. (2012). Also, the patients were evaluated for the anatomic location of gastritis that including three major locations; antrum, antrum predominant pangastritis and corpus predominant gastritis, and patients were considered endoscopically normal, if the gastric mucosa was pink, smooth and lustrous (Yesim et al., 2004).

Histopathology

The biopsies were collected, placed on filter paper, fixed in 10% formalin, and sent for preparation of formalin-fixed, paraffin-embedded blocks, then tissue sections with 3 micron thickness were obtained. One slide was stained by routine (H&E), and the other with Giemsa stain for histopathological examination (by 2 experienced pathologists) including detection of *H. pylori* in the gastric mucosa.

The biopsies were evaluated for the intensity of mononuclear inflammatory cellular infiltrates, inflammatory activity, glandular atrophy, metaplasia and dysplasia (Dixon et al., 1997). Additionally, cases of chronic gastritis were graded according to the grading system that was provided by Houston-updated Sydney system (Dixon et al., 1996), which was depended on the intensity of mononuclear inflammatory cellular infiltrates within the lamina propria into 4 scales as follows: absent inflammation (grade 0), mild (grade 1), moderate (grade 2) and severe (grade 3) (Dixon et al., 1996).

Statistical analysis

The statistical analysis was undertaken using SPSS computer software (SPSS version 16 Microsoft windows). Z test was used for the comparison between two proportions. Results were considered to be statistically significant at $p < 0.05$.

RESULTS

Clinicoendoscopical findings

Patients' age, ranged from 20 years to 80 years with average 47 years and 63 out of all patients were males and 37 were females. All patients complained of heart burn, and nausea with epigastric pain that did not respond to ordinary treatment. Upper endoscopy revealed 5% of the patients showed normal appearing gastric mucosa. Findings of endoscopic gastritis detected in 83 patients ($p < 0.001$), among them hyperemia seen in 54, erosion in 14, ulceration in 3, and nodularity in 12 patients. Regarding the anatomic location of endoscopic gastritis, antral type-gastritis found in 63 patients ($p < 0.001$), antrum predominant pangastritis in 13, and corpus predominant gastritis detected in seven patients. Also, findings of endoscopic duodenitis in the form of hyperemia and ulceration were seen in 12 patients.

Histopathological findings

In concern to histopathological evaluation of the prcessed antral and body type gastric biopsies mononuclear inflammatory cellular infiltrates detected in 95 cases ($p < 0.001$). In relation to the intensity of these infiltrates,

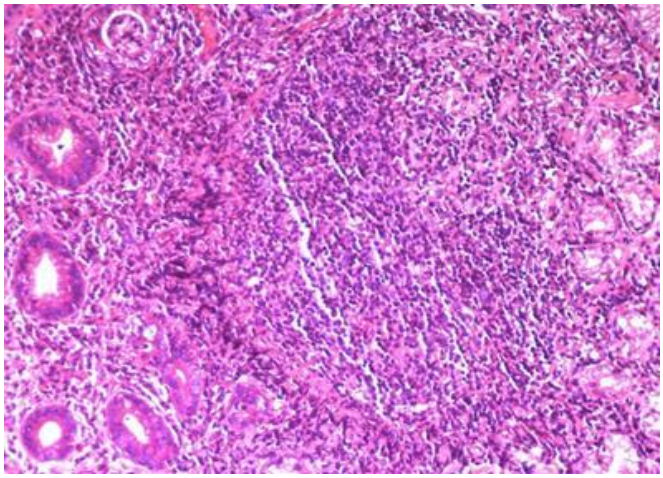

Figure 1. A case of G3 gastritis showing lymphoid follicle formation with severe mononuclear cellular infiltration in the lamina propria (H&E 200X).

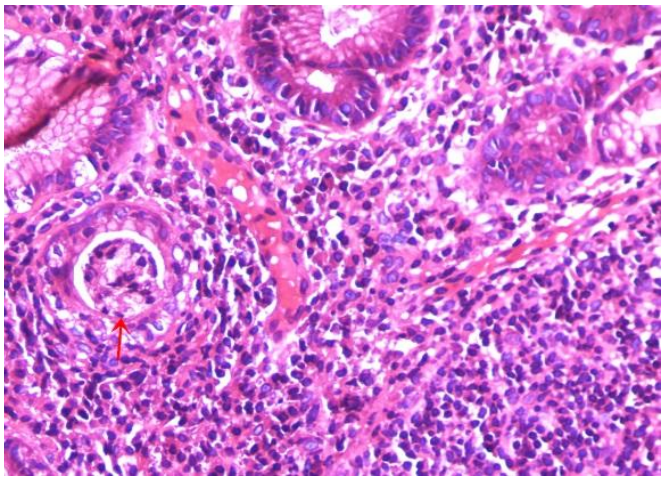

Figure 2. A case of G3 gastritis revealing active inflammation with neutrophils in the glandular lumen (arrow) and severe mononuclear cellular infiltration in the lamina propria (H&E 200X).

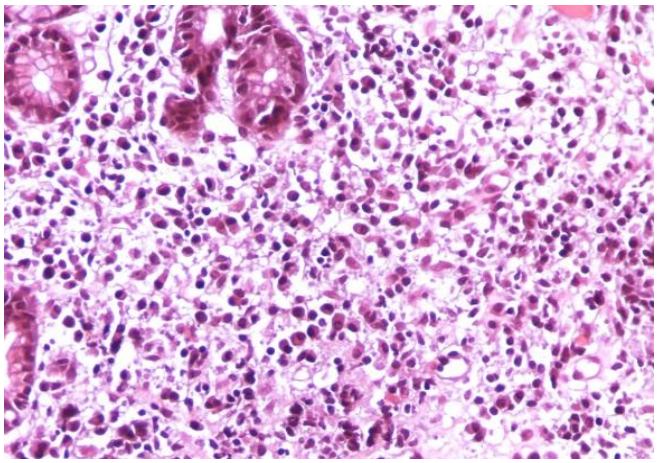

Figure 3. A case of G3 gastritis showing glandular atrophy with severe mononuclear cellular infiltration in the lamina propria (H&E 200X).

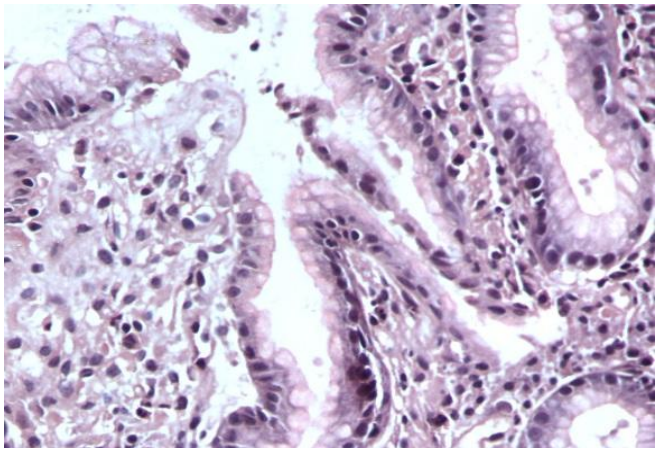

Figure 4. A case of G2 gastritis showing intestinal metaplasia with moderate mononuclear cellular infiltration in the lamina propria (H&E 200X).

absent inflammation (G0) observed in 5 cases, grade 1 gastritis (G1) in 64 ($p < 0.001$), grade 2 gastritis (G2) in 16, and grade 3 gastritis (G3) found in 15 cases ($p < 0.001$). In addition to the above, lymphoid follicles with germinal center formation were seen in 6 cases (Figure 1), whereas active inflammation with neutrophilic infiltration were identified in 10 cases (Figure 2). Also, 7 cases showed mucosal glandular atrophy (Figure 3), one case revealed intestinal metaplastic changes (Figure 4), and another one revealed dysplastic changes (Figure 5). *H. pylori* colonization found in 92 cases (Figure 6) ($p < 0.001$), one among them was gastric adenocarcinoma develops on top of *H. pylori*-induced chronic gastritis. Eight cases were free from *H. pylori* infection. Among *H. pylori* infected cases, findings of endoscopic gastritis were seen in 83 patients, and the ratio between endoscopic findings and histopathological positivity of *H. pylori* was 90.2%, as well as *H. pylori* seen in the majority of patients with endoscopic findings of duodenitis (91.7%) ($p < 0.005$) .

Regarding all the parameters of endoscopy and histopathology, there is insignificant correlation between grade 1 gastritis (G1) and endoscopic hyperemia ($p > 0.001$), yet the latter revealed significant relation with *H. pylori* colonization, as well as *H. pylori* colonization reveals a significant correlation with endoscopic duodenitis ($p < 0.001$) (Table 1). Histologically, *H. pylori*, mononuclear inflammatory cellular infiltrates, lymphoid follicles and inflammatory activity observed among most

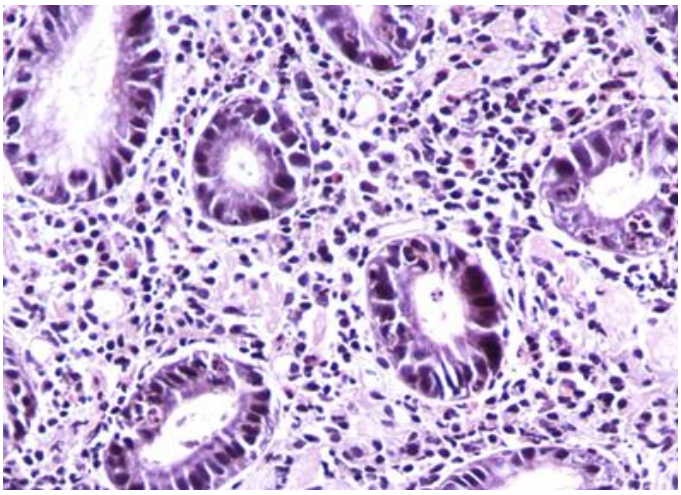

Figure 5. A case of G2 gastritis revealing dysplastic changes with moderate mononuclear cellular infiltration in the lamina propria (H&E 200X).

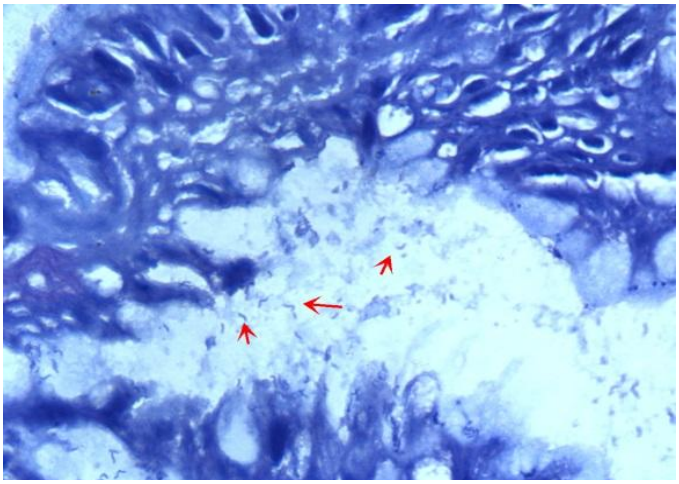

Figure 6. A case of G2 gastritis showing severe *Helicobacter pylori* colonization within the superficial mucus overlying the foveolar epithelial cells (arrows) (giemsa stain 400X).

of the studied cases (95%) with ($p < 0.001$).

DISCUSSION

Despite its declining incidence, gastric cancer (GC) (especially the intestinal-type mainly associated with *H. pylori* infection) is still a highly lethal malignancy (Parkin et al., 2005) as well as primary prevention though *H. pylori* eradication is consistently recommended (Correa et al., 2000; Leung et al., 2004). Gastric mucosal atrophy is generally considered the “cancerization field” in which GC develops. Based on such a rationale, and incorporating the experience gained with the Sydney system (Dixon et al., 1996) and the international group (Operative Link on Gastritis Assessment) (OLGA) proposed an equivalent grading and staging systems for reporting gastric histology rank gastritis-induced cancer risk according to both the topography and the extent of glandular atrophy (Rugge et al., 2008; Rugge et al., 2010). The available clinicopathological classifications of gastritis are inconsistently used, possibly because most of them do not provide clinicians with immediate prognostic and therapeutic information. In addition, because they lack explicit ranking of severity, the descriptive labels of chronic gastritis carry the risk of being misinterpreted by general practitioners (Rugge et al., 2007).

In this study the endoscopical findings of gastritis revealed a significant relation with majority of patients showing hyperemia (54 patients) ($p <0.001$), followed by erosion in 14, mucosal nodularity in 12, and ulceration in 3 patients ($p <0.005$). There is a significant correlation between endoscopical findings and anatomic location of gastritis as antral type represents the major one ($p <0.001$). Additionally, the endoscopical findings of gastritis and duodenitis revealed a significant relationship (83 and 12 patients, and $p <0.001$). Histologically, 95 cases revealed mononuclear inflammatory cellular infiltrates, and 5 cases were G0. Among the former cases G1 gastritis observed in 64 cases, G2 in 16 cases and G3 in 15 cases. The relation between these grades of gastritis was significant ($p <0.001$). Lymphoid follicles found in 6 cases ($p <0.001$), inflammatory activity in 10 cases ($p <0.001$), glandular atrophy in 7 cases, intestinal metaplasia and dysplasia each of them observed in one case ($p <0.001$). The relationship between endoscopical findings, inflammatory infiltration and *H. pylori* colonization was significant ($p <0.001$), whereas the relation between G0 gastritis and hyperemic gastric mucosa was insignificant ($p >0.001$). Additionally there was a higher significant correlation between *H. pylori* colonization and hyperemia, as well as with gastric erosion, and duodenitis ($p <0.001$). All grading of gastritis (G1, 2, and 3) showed *H. pylori* colonization, whereas G0 was negative, and 2 patients of endoscopically normal appearing gastric mucosa revealed *H. pylori* colonization. Our endoscopical findings are in agreement with a study revealed by the presence of erythema in 68% of patients, antral erosion in 7%, duodenal ulcer in 5% and normal gastric mucosa in 20% out of 300 patients (Garg et al., 2012). Calabrese et al. (1999) reported erythema in 44 and 43% of patients, respectively, and Yesim et al. (2004) found endoscopic gastritis in 54 out of 64 patients (84%), the majority showed endoscopic erythematous / exudative gastritis (81.3%).

In this study mononuclear inflammatory infiltrates detected in majority of biopsies (95/100), as well as various grades of gastritis were seen, whereas 5% of our cases were G0. Garg et al. (2012) found mononuclear inflammatory infiltrates in the majority of the cases (70%) with 20% of them were endoscopically normal, yet they showed chronic inflammation on histology. Our results

Table 1. Correlation between endoscopic and histopathological findings of all cases studied.

Histological feature	Endoscopical finding					
	Endoscopic gastritis No. 83				Duodenitis No. 12	Normal No. 5
	Hyperemia No.= 54	Erosions No.= 14	Ulcerations No.= 3	Nodularity No.= 12		
Infla. cells						
Go= 5	1	-	-	-	-	4
G1= 64	47	4	-	6	6	1
G2= 16	4	3	1	2	6	-
G3= 15	2	7	2	4	-	-
Activity= 10	2	3	2	3	-	-
Lymphoid F= 6	-	1	2	3	-	-
Atrophy= 7	-	2	2	2	1	-
Metaplasia= 1	-	-	-	1	-	-
H.P = 92	53	13	2	11	11	2

Infla, inflammatory; No., number of cases; F, follicles; H. P, *helicobacter pylori* colonization.

are in parallel with Khan et al. (1999) who found 32% of patients with chronic gastritis histologically had normal endoscopical findings, hence emphasizing the role of biopsy even in normal endoscopic cases.

The endoscopical finding of mucosal nodules may be not an essential diagnostic parameter as a study conducted by Nakashima et al. (2011) who reported lymphoid follicles were not present at the sites of endoscopically identifiable nodules and patients with endoscopically diagnosed nodules showed them in areas ranging from the gastric antrum to the gastric angulus, but histological features of them observed in areas extending from the antrum to the corpus. Additionally, a surprise mentioned by Matsushia and Aftab (2012) who found the scores of chronic inflammation, neutrophil activity, glandular atrophy and intestinal metaplasia were significantly lower with *H. pylori* positive Bangladeshis then in Japanese at all gastric sites, they linked this to a hypothesis that is related to *H. pylori* strains and these patients are typically infected with a Western-type of *H. pylori* (Vilaichone et al., 2004). Regarding the anatomic location of endoscopic gastritis in our study, antral type represents a higher percentage (63%) followed by antrum predominant pangastritis (13%) and corpus predominant that encompasses 7%. These findings are in agreement with Matsushia et al. (2007) who reported antral gastritis represented a higher percentage of endoscopic gastritis regardless age period of patients, yet our findings are in disagreement with Uemura et al. (2001) who reported corpus predominant gastritis represented a higher percentage in Japanese patients. So, the pathogenesis of *H. pylori*, anatomic location of gastritis may be changeable according to the *H. pylori* strains and residency.

In this study the sensitivity of endoscopical abnormalities for gastritis was 90.2%, a previous study performed on 100 patients found this sensitivity 91.7% (Al-Hamdani et al., 2001). In this study grade 1 gastritis (G1) found in 67.4%, G2 in 16.8%, and G3 in 15.8% and all of them revealed *H. pylori* colonization; this is in agreement with a study of (Rugge et al., 2007) who found G1 gastritis in 68%, G2 in 14%, and G3 in 12% of cases studied. Also, the same study discussed that duodenal ulcer found in 86% of patients is associated with gastritis. Histologically, *H. pylori* is detected in the majority of our biopsies (92%) including patients with hyperemia, erosion and nodularity. Patients with duodenitis showed *H. pylori* colonization in 91.7%. Inflammatory activity with neutrophils is found in 10 cases, and glandular atrophy in 7 cases, whereas intestinal metaplasia and dysplasia are each seen in one case. Most of these findings are in agreement with Garg et al. (2012) who observed *H. pylori* in patients with hyperemia and erosion in 37 and 57%, respectively and also found mononuclear inflammatory cellular infiltrates in all cases with the majority (70%) exhibiting mild inflammation (G1) while, 27% showed moderate inflammation (G2). Reported 33% of Garg et al. (2012) cases showed an activity which is not parallel to our findings and this may be attributable to the large number of his cases (300). The same previous author found glandular atrophy in 12.3% and intestinal metaplasia in 7% of cases that are near to our findings, as well as in accordance with findings observed by Atisook et al. (2003) and Hussein et al. (2009). In the current study *H. pylori* is found in 92% of all biopsies which is near to study done by Kumar et al. (2006) who showed positivity in 78%.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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