BSJournals

Volume: 5
Issue: 1

Black Sea Journal of Agriculture

ISSN: 2618 - 6578

BLACK SEA JOURNAL OF AGRICULTURE

(BSJ AGRI)

Black Sea Journal of Agriculture (BSJ Agri) is a double-blind peer-reviewed, open-access international journal published electronically 4 times (January, April, July and October) in a year since January 2018. It publishes, in English, full-length original research articles, innovative papers, conference papers, reviews, mini-reviews, rapid communications or technical note on various aspects of agricultural science like agricultural economics, agricultural engineering, animal science, agronomy, including plant science, theoretical production ecology, horticulture, plant breeding, plant fertilization, plant protect and soil science, aquaculture, biological engineering, including genetic engineering and microbiology, environmental impacts of agriculture and forestry, food science, husbandry, irrigation and water management, land use, waste management etc.

ISSN: 2618 - 6578

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Web site: http://dergipark.gov.tr/bsagriculture

Sort of publication: Periodically 4 times (January, April, July and October) in a year

Publication date and place: January 01, 2022 - Samsun, TURKEY

Publishing kind: Electronically

EDITORIAL DECLERATION

Dear authors and readers,

First of all, we would like to thank you for being our travel companion by writing, evaluating, and reading us about this broadcasting life we started five years ago. With these thoughts, we are especially thankful for researchers and academicians honoring with the articles, valuable scientists involved in editorial boards, and reviewers for their contributions to the evaluation processes through their opinions/ideas/contributions/criticisms. With this article, we wanted to inform you, our valuable stakeholders, about the development of The Black Sea Journal of Agriculture (BSJ Agri). The statistics of the BSJ Agri for the last four years are given below. Hope you will be with us in future issues.

Year	Articles	Cites	Cite İndex*	CNA	CNC	CCI
2018	23	26	1.13	23	26	1.13
2019	36	15	0.42	59	41	0.69
2020	49	11	0.22	108	52	0.48
2021	23	2	0.09	131	54	0.41

CNA= cumulative number of articles, CNC= cumulative number of cite, CCI= cumulative cite index

*: according to Scholar Google

Rejection rate:

- 2020: 18%
- 2021: 13%

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Average time from send to publish (days): 157

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Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.945710

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
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MEDICAL PLANT OF ALOE VERA IN DESERT REGIONS OF IRAN: GREENHOUSES, ECONOMIC IMPORTANCE, DEVELOPMENT, EXTENSION, PROCESSING AND MARKETING

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Abstract: Medical plants are the best source for getting treatment from various diseases. Using of natural substances with therapeutic properties has been used since ancient times. More than 500 species of Aloe Vera are known. This plant is native to tropical areas, including the north of Africa, Europe and the southern part of the Mediterranean region. Aloe Vera grows widely in the south of Iran and is cultured for the pharmaceutical uses. Aloe Vera is a plant with structural and physiological adaptations that allow it to survive in arid or semiarid regions with erratic rainfall. Aloe Vera is a medicinal plant cultivated for various applications in medical, food and health products. Aloe Vera has been used for centuries for its health, beauty, medicinal and skin care properties. Aloe Vera is a plant that can produce sap and gel. The gel is extracted from the leaves, and this is the most widely used substance as a treatment. Different from traditional treatment modalities, Aloe Vera will great reduce medical cost intended as complementary therapy. Aloe Vera is much more effective and less costly in the prevention and healing the ulcers compared to current treatments. Also, since the revival of traditional medicine is important and the side effects of this drug has been proven to be trivial over the years, it seems Aloe Vera is a good substitute to replace the current methods or to be used as a complementary method for prevention of pressure ulcers and improving community health. In this article, introducing various aspects of cultivating Aloe Vera greenhouses in desert regions of Iran and their economic importance plus approaches for their development, extension, processing and marketing. Main locations of study were greenhouses of Aloe Vera in two provinces in Iran, namely South Khorasan and Semnan provinces in the east and north of the country. For doing this study utilized qualitative approach with its main tools for gathering information such as participatory observation, maps, scientific articles, pictures, documents etc.. In the end present appropriate approaches for improving its economic importance, development, extension, processing and marketing in Iran.

Keywords: Aloe Vera, Greenhouses, Desert regions, South Khorasan province, Iran

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Received: May 31, 2021
Accepted: October 06, 2021
Published: January 01, 2022

Cite as: Golmohammadi F. 2022. Medical plant of Aloe Vera in desert regions of Iran: greenhouses, economic importance, development, extension, processing and marketing. BSJ Agri, 5(1): 1-15.

1. Introduction

Medical plants are the best source for getting treatment from various diseases. Using of natural substances with therapeutic properties has been used since ancient times. Aloe Vera is a medical which has many benefits that is used in medicine to several problems in the health of human body. Aloe Vera is a plant that can produce sap and gel. The gel is extracted from the leaves, and this is the most widely used substance as a treatment (Rozani and Kusbaryanto, 2019). Aloe Vera is one of the few succulent plants that throughout history has maintained an important place in the pharmacopoeias of various cultures of the world. It was used by the ancient Egyptians in mummification rituals, and in China and India, it has been applied in traditional medicine since 400 BC. Dioscorides mentions its use for the treatment of almost all ailments, from insomnia to itching of the eyes (Imery-Buiz, 2012). Aloe Vera is a medicinal plant cultivated for various applications in medical, food and health products (Singh et al., 2021).

Aloe Vera is an herbaceous and perennial plant that belongs to the Liliaceae family and used for many medicinal purposes (Hekmatpou et al., 2019). *Aloe barbadensis* Miller (Aloe Vera), is a perennial plant of the lily (Liliaceae) or Aloeaceae family, which is a tropical or subtropical plant characterized by lance shaped leaves with jagged edges and sharp points (Safari et al., 2019).

Aloe (Aloe Vera L., Liliaceae family) has applications in health and cosmetic products as well as antioxidant, anticancer, anti-inflammatory, laxative, anti-atherosclerosis properties. It includes 75 active components that contain vitamins, enzymes, minerals, sugars, Lignin, salicylic acid, and amino acids. Plenty of major components such as: Aloe-emodin, Aloetic-acid, Anthranol, Barbaloin, Mannan and its derivatives, 8-C-glusoly-(2′-Ocinnamoly), −7-O-methlyaloediol A, Alkaline phospha amylase, bradykinase, carboxypeptidase, catalase, cyclooxidase, cyclooxygenase, lipase, oxidase, phosphoenolpyruvate, carboxylase, superoxide

dismutase, Calsium, Chlorine, Chromium, Copper, Iron, Magnesium, Arachidonic acid, Y-linolenic acid, steroids, Mannose, glucose, L-rhamnose, Aldopentose, Vitamin A, B12, C, E, choline and folic acid, Auxins and Gibberellins have been found (Alinejad-Mofrad et al., 2015).

Aloe Vera is a stem less or very short-stemmed plant growing to 60-100 centimeters (24-39 inches) tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on their upper and lower stem surfaces. The margin of the leaf is serrated and has small white teeth. The flowers are produced in summer on a spike up to 90 cm (35 in) tall, each flower being pendulous, with a yellow tubular corolla 2–3 cm ($^3/_4$–1 $^1/_4$ in) long. Like other Aloe species, Aloe Vera forms arbuscular mycorrhiza, a symbiosis that allows the plant better access to mineral nutrients in soil. Aloe Vera leaves contain phytochemicals under study for possible bioactivity, such as acetylated mannans, polymannans, anthraquinone C-glycosides, anthrones, and other anthraquinones, such as emodin and various lectins (Jamshidi et al., 2018). Aloe Vera is a xerophytic plant with structural and physiological adaptations that allow it to survive in arid or semiarid regions with erratic rainfall (Imery-Buiz, 2012).

This plant has triangular leaves. Fleshy with jagged edges, yellow tubular flowers and fruits which contain a lot of seeds. Every leaf consults of 3 clear get which of containing 99% water and the other are made of glucomannan, amino acid, lipids, sterols, vitamins, and middle lays of latex which of bitter yellow sap and contains anthraquinone, glycosides, and thick out layer of is 15-20 cells referred to as peel that has a protective function, synthesize carbohyidrates and proteins. Inside the skin is a collection of blood vessels responsible to transport substances such as water (xylem) and starch (phloem). Various Aloe Vera extracts are mate to be easy is used in medicine to humans like gel, oil, juice, and tablets. In several researches in-vitro indicate that Aloe Vera leaves showed contain more than 75 nutrients and 200 active compounds, including 20 minerals, 18 amino acids and 12 vitamins. Also contain the most important components which are needed by the human body. Aloe Vera has vitamins A, B1, B2, B6, B12, C and E. Aloe Vera has a high enzyme content (for about 92 enzyme), which makes it a rare source and valuable because of enzyme help the body absorb basic nutrients at the same time purifying it and used as an antifungal, anti-inflammatory, anti-septic, can be used to accelerate the healing process of wounds. By looking at kinds of treatment using Aloe Vera above, so that was done a deep literature to treatment using Aloe Vera in dealing with health problems. Aloe Vera can also be used as therapy or treatment in melasma patients with fix function skin pigment. Utilization of treatment using Aloe Vera proven to accelerate the process of wound healing and decrease some health problems of pain intensity (Rozani and Kusbaryanto, 2019).

Its therapeutic potential is demonstrated every day in the many laboratories, medical centers, and traditional hospitals that study and evaluate natural healing alternatives for diseases such as cancer, as well as gastrointestinal, skin, cardiovascular, respiratory, and metabolic disorders. Their investigations have found that the administration of A. Vera extracts acts successfully as a treatment to alleviate these conditions, both by itself or as a coadjutant of formal medicine effects. There are currently over 800 km^2 cultivated with A. Vera, mainly in dry regions in the Americas, southern Europe, Africa, Arabia, India, China, and Australia; they produce the raw material for the food, pharmaceutical, and cosmetics industries. Agricultural and industrial activities based on A. Vera have a projected annual growth of nearly 8% with an overall market of about US$200 billion. However, low genetic variability and the emergence of phytosanitary problems threaten crop productivity, generating the need to better understand ecological and agronomic aspects of this species and to search for new cultivars. Several research centers worldwide have oriented their efforts in this direction, carrying out basic studies in genetics, biotechnology, physiology, ecology, reproductive biology, plant pathology, entomology, and other scientific disciplines in order to obtain pathogen-tolerant experimental genotypes together with increases in crop yield, efficiency, and quality (Imery-Buiz, 2012).

Aloe Vera is much more effective and less costly in the prevention and healing the ulcers compared to current treatments. Also, since the revival of traditional medicine is important and the side effects of this drug has been proven to be trivial over the years, it seems Aloe Vera is a good substitute to replace the current methods or to be used as a complementary method for prevention of pressure ulcers and improving community health (Hekmatpou et al., 2018).

The succulence of the leaves is a xerophytic adaptation based on the presence of a specialized tissue (hydro parenchyma) where water is stored in large cells with thin walls. Mucilage contained in this tissue maintains the water status of the plant, due to little variation in its water potential even in drought conditions. A. Vera plants show crassulacean acid metabolism (CAM) and open their stomata at night to convert atmospheric carbon dioxide into malic acid, which they use to perform photosynthesis during the day, when their stomata are closed to prevent loss of moisture. The CAM activity and the accumulation of large quantities of polysaccharides in the leaves are mechanisms of drought resistance and may aid the rehydration of other leaf cells with a lower water potential (Imery-Buiz, 2012).

Aloe, which originated from Africa under dry and hot weather conditions, is currently growing worldwide in tropical and subtropical areas. It is well recognized for its extremely high utilization qualities and its ability to adapt to various environments, making it easy for cultivation in other parts of the world with hot and humid climates (Young In and Hyung, 2006). More than

500 species of Aloe Vera are known. This plant is native to tropical areas, including the north of Africa, Europe and the southern part of the Mediterranean region. A. Vera grows widely in the south of Iran and is cultured for the pharmaceutical uses (Safari et al., 2019). In this article, introducing various aspects of cultivating Aloe Vera in greenhouses in desert regions of Iran (especially South Khorasan and Semnan provinces in the east and north of the country) plus its open farming in other provinces and their economic importance plus approaches for their development, extension, processing and marketing (Figure 1).

Figure 1. An Aloe Vera greenhouse that belonging to an urban educated woman entrepreneur that has academic degree in agricultural engineering - with 15 km distance of greenhouse to Birjand, center of South Khorasan Province, east of Iran (By author; Spring, 2021).

2. Extent and Amount of Aloe Vera Production in Iran

Cultivating of Aloe Vera for supplying to market in Iran has been begun less than one decade and therefore isn't available a national statistics for its extent and amount of Aloe Vera production in all of the provinces of Iran and in the level of the country. In north provinces of the country such as Guilan and Mazandran provinces and south and west provinces such as Bushehr and Ilam provinces we see dominance cultivating of Aloe Vera in open farms because of availability good conditions such as high degree of humidity and temperature. In these provinces we see also cultivating of Aloe Vera in greenhouses in fewer extent especially by academic agricultural graduated in Iran.

For example, in Bushehr province in south west of Iran and in besides of Seashores of Persian Gulf we see most extent of Aloe Vera farms in open air in 100 ha with annual production 2400 tons of its leaves (Figure 2).

Figure 2. Plantation of Aloe Vera in farm in a village near Ilam city, capital of Ilam province, south west of Iran, and near borders of Iraq, spring 2012. (Noori, 2012).

But in desert provinces such as South Khorasan and Semnan provinces we see cultivating of Aloe Vera in greenhouses in 3.5 and 4 ha exclusively. In these provinces Aloe Vera can't grow in open air farms because of its high sensitivity to below degrees temperatures (under zero centigrade) that cause die of this plant (Table 1).

Table 1. Situation of stakeholders in Aloe Vera greenhouses in South Khorasan and Semnan provinces

Items	South Khorasan province	Semnan province
Extent of Aloe Vera greenhouses (ha)	3.5	4
Number of stakeholders	6	10

In Khorasan Razavi province in north east of Iran, there are 22 ha Aloe Vera in greenhouses and less than 2 ha Aloe Vera farms in open air with total 7000 tons annual production of its leaves.

Also greatest and most extensive complex of Aloe Vera in greenhouses is available in Mashhad city center of Khorasan Razavi province in extent of 2 ha that contains 20 Aloe Vera greenhouses and provide employment for 40 persons directly and 120 persons indirectly.

In Delgan city with 478 km distance to Zahedan city center of Sistan and Baluchestan province in south east of Iran and in besides of Seashores of Oman sea and Indian ocean, 50 ha Aloe Vera farms in open air cultivated first time in 2020 that there aren't precise statistics of their production yet.

In other provinces of Iran Aloe Vera cultivated in open air farms (less) and greenhouses (more) in extent of 1-2 ha with an average production of its leaves 40 – 60 tons

annually, that there aren't precise statistics on their cultivating extent (Iranian Bureau of Statistics, 2021).

3. Physical Description

Aloe Vera is an evergreen, perennial, succulent (cactus - like) plant that has gray - green, simple, lance - shaped leaves with a pointed apex (lanceolate). The leaves do not have stalks (petioles). The margins have small grayish teeth. The leaves are arranged alternately to form a rosette above a very short stem. The main rosette reaches approximately 2 feet (61 cm) in height, and the plant continually produces little offset rosettes. The flowers are regular, bisexual, yellow to orange in color, and appear in terminal series of flowers on lateral stalks (racemes). These flowers produce capsules with many flattened seeds (Figure 3) (Barceloux, 2008).

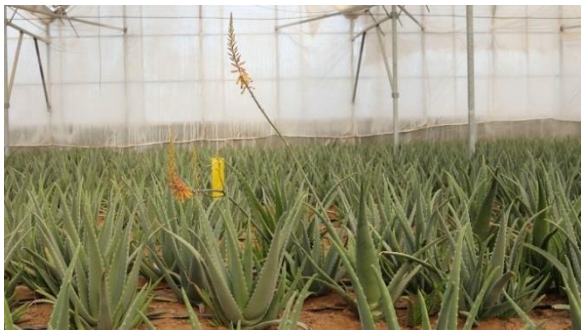

Figure 3. These flowers produce capsules with many flattened seeds. In a greenhouse with 15 Km distance to Birjand, center of South Khorasan Province, east of Iran (By author; Spring, 2021).

4. Distribution and Ecology

The overexploitation of natural populations of Aloe Vera for over 3000 years due to their direct use for medicinal purposes, as well as their introduction, cultivation, and marketing in different regions of the world, makes the origin of Aloe Vera uncertain. Aloe Vera can be found anywhere in the world, but its extensive cultivation is limited to tropical and subtropical regions. In the Americas, it is commercially exploited in large plantations in the southern United States, Mexico, the Dominican Republic, Haiti, Puerto Rico, Cuba, the Bahamas, Barbados, Aruba, Bonaire, Curacao, Belize, Guatemala, Costa Rica, Colombia, Venezuela, Ecuador, Brazil, Peru, Bolivia, and down to northern Chile, Argentina, and Paraguay (Imery-Buiz, 2012).

Aloe adapts well to desert climates. This plant is native to Arabia and Madagascar, but the largest distribution occurs in South Africa. In the United States, Aloe Vera grows in the drier parts of Texas, Florida, Puerto Rico, and Hawaii (Barceloux, 2008). Among the various Aloe species used for medical purposes are Socotra aloe (Aloe perryi Baker), which can be found in the African Somalia and Socotra Island region, Cape Aloe (*Aloe ferox* Miller, *Aloe Africana* Miller, *Aloe spicata* Baker), which is found near the African Cape Town region, and Curacao aloe (*Aloe barbadensis* Miller), which is found in parts of Mexico, Central America, the Caribbean and most recently Florida and southern Texas. *Curacao aloe* is better known as Aloe Vera.

These aloe species are currently listed in the pharmacopeia of many countries in forms of plain aloe, extract and/or powder (Young In and Hyung, 2006).

In Aloe Vera pots, the species requires well-drained, sandy potting soil and bright, sunny conditions. Aloe plants can turn red from sunburn under too much direct sun, though gradual acclimation may help. The use of a good-quality commercial propagation mix or packaged "cacti and succulent mix" is recommended, as they allow good drainage (Jamshidi et al., 2018).

5. Aloe Vera Traditional Medicinal Uses in Various Ancient Cultures

Aloe Vera has been used for centuries for its health, beauty, medicinal and skin care properties (Sahebnasagh et al., 2020). At present, a number of prescribed drugs come from plants. The medicinal properties and ornamental value of Aloe Vera have been recognized by civilizations throughout the world and are described in ancient documents, including the Bible. Aloe Vera has been used for medical purpose in several cultures for a thousand of years Egypt, India, Mexico, Japan and China. In the Old World, it is cultivated throughout the Mediterranean and other dry areas of Spain, Italy, India, South Africa, the Arabian peninsula, China, Malaysia, Japan, Australia, Vietnam, Taiwan, and Nigeria. Aloe Vera is a medicinal plant from 1500 years BC in many countries, including Greece, China, Mexico, which had been traditionally used for centuries as a local medicine for various diseases and skin lesions. The use of Aloe plants as magical and superstitious symbols is widespread throughout the world, especially in Africa and in those places where people of African descent live or where components of their culture have been adopted. In the Caribbean and other American countries, whole Aloe Vera plants are placed above the entrance doors to houses as a warning to people with malicious intent and to keep adversities of all kinds at bay. Some people even put coins at the base of the plants in the hope of economic prosperity for their families (Imery-Buiz, 2012).

Traditional uses of Aloe Vera include the treatment of arthritis, asthma, fungal infections, digestive and bowel disorders (e.g., constipation), lupus erythematous, skin disorders (e.g., seborrheic dermatitis), musculoskeletal injuries, and gastro duodenal ulcers. Other uses include application as an insect repellant and the treatment of diabetes mellitus, antihemorrhoidal agent, gout, tuberculosis, gonorrhea, headaches, and eczema (Barceloux, 2008).

Different from traditional treatment modalities, Aloe Vera will great reduce medical cost intended as complementary therapy (Rozani and Kusbaryanto,

2019).

Succulent Aloe plants have been used to treat wounds since ancient times and are mentioned in the Ebers papyrus, an important medical text of ancient Egypt, dating from 1550 BCE (Edwards et al., 2015).

Currently there are over 360 known species of aloe and it has been used for medical purposes for probably at least 4000 years. The use of this plant for medical needs has already been revealed by historical records in regions such as ancient Persia and Egypt, Greece, Rome, India, Africa, China, Korea and Japan. Later, with the Spanish discovery of the Americas, aloe completed its spread throughout all inhabited continents of the world. The first record of human use of Aloe is the Sumerian hieroglyphic alphabets engraved on clay tablets during the Mesopotamia civilization circa 2200 BC. According to them the aloe leaves were used as a laxative. Scriptures on the Ebers papyrus that were found inside the tombs of mummies in the Egyptian Tebe region show 12 formulas that used aloe with other ingredients to produce internal medicine or a medicine for external use, further proving the use of the plant. Material Medica, which was written by Hippocrates circa 450 BC, did not have any direct indication of aloe, but according to the Indian medication writing called the Copra (which was written during the same era) aloe was used for healing external wounds and constipation. The Greek Herbal written by Dioscoreded circa 41 AD recorded detailed information on the use of Aloe Vera and its extracts for wound healing, treatment of gum diseases and constipation during the Roman expedition. The hemostatic use was also reported when in dried power form. Meanwhile, according to the Chinese 'Gebobоncho' written during the Song dynasty, aloe was used for curing skin diseases named as 'Nowhae'. As this word was used later in other parts of China, Korea and Japan, it could be assumed that these three countries used imported aloe in the form of dried concentrate for their medical needs. In Korea, the 'DongeuiBogam' written by Joon Hur has the term 'Nowhae' added to its text as well. Aloe was cultivated in the Barbados and Curacao Islands in the Caribbean region by Spain and the Netherlands and was sold commercially to various parts of Europe during the 17th century. Since its first recording in pharmacopeia in Germany during the 12th century, aloe has been listed as a laxative in pharmacopeia in 20 countries. Afterwards, following detailed research on the qualities and effectiveness of aloe, it has been used for a wide variety of medical purposes (Young In and Hyung, 2006).

6. Aloe Vera as a Functional Food

Functional foods are defined as foods that are consumed as part of a usual diet but have physiological effect and/or reduce the risk of chronic disease beyond basic nutritional functions. Reports show that Aloe Vera (*Barbadensis* Miller) gel (AG) contains nutrients and functional activities such as decreasing hyperglycemia. It also reported that a polyphenol extract from Aloe Vera gel decreased glucose levels in induced insulin resistance in mice. (Cardenas-Ibarra et al., 2019).

7. Heat-treated Dried Powder from Aloe Vera

The reason why extracts from Aloe are used in a form of heat-treated dried powder for medical purposes is because its high water content later causes putrefaction. Before the development of technology for its processing and manufacturing, the only way to produce Aloe was presumably the traditional heat dry method. For medical purposes Aloe has been used as a laxative, a tonic medicine, or a peptic. Anthraquinones such as aloin and barbaloin are known to be major components (Table 1) (Young In and Hyung, 2006).

Table 2. Aloes for medical uses (Young In and Hyung, 2006)

Pharmacopeia	Species	Usage	Major component
JP, BP, EP, etc.	*Aloe ferox* Miller, *Aloe Africana* Miller, *Aloe spicata* Baker and their hybrids	Laxative	Anthraquinones
USP	*Aloe barbadensis* Miller (Aloe vera)	Laxative	Anthraquinones

8. The Use of Aloe for Food and Cosmetic Purposes

Aloe Vera gel extracts began to be used for health foods / beverages and moisturizing cosmetics, starting in the United States and parts of Europe, during the 1970s. Aloe Vera was especially cultivated and supplied in mass in the United States from its vast farming lands and automated farming methods. Aloe was later produced in the forms of gel extract and powder in order to increase its value as a product in the commercial market, contributing to increased consumption and demand for aloe. The leaves of Aloe Vera are thick and full of pulpy substances compared to other aloe species. The "Aloe Vera gel solution" is a pulpy substance containing polysaccharides which is made of inner gel without the outer layer of leaves and contains almost no anthraquinones. This solution is also produced in powder form as "Aloe Vera gel powder". This powder is originally used only as a vehicle or a diluent in medicines, and as a skin moisturing agent for creams, lotions, soaps, conditioners and shampoos, whereas the yellow sap containing anthraquinones mostly between the outer layer and the gel layer was used in medical purposes. The development of Aloe as a raw material for health food is based on safety rather than pharmacological activity so

that aloe has been processed to eliminate anthraquinones which show an alleviation activity for constipation. The gel contains mainly macromolecules such as cellulose, polysaccharides and glycoproteins. The pattern of food consumption has been changing with increased intake of animal proteins and fats rather than plant celluloses. In the light of this, Aloe serves as a good low calorie supplement for providing celluloses, improving fatness, and lowering cholesterol levels. Moreover, Aloe Vera gel extracts have also been used for mucosal regeneration of the stomach and intestine and for skin care. Other species of Aloe that were expanded for use in health food purposes include *Aloe Arborescens* Miller and *Aloe Saponaria* Miller, but their leaves are thinner and contain much less gel. This lead to the use of whole leaves, but their use remains very limited due to concerns over the amount of gel and the side effects of anthraquinones. However, it has been known that *Aloe saponaria* contains no anthraquinones. Three species of Aloe, Aloe vera, *Aloe arborescens* and *Aloe saponaria*, are currently listed in the Food Code and Food Supplement Code of Korea and Japan (Table 3) (Young In and Hyung, 2006).

The German Commission E approves the use of aloe for the limited (1-2 weeks) treatment of constipation. The US Food and Drug Administration (FDA) does not permit the use of aloe products as nonprescription drugs for treatment of constipation because of the lack of documented efficacy and safety. Aloe products are controlled as dietary supplements in the United States (Barceloux, 2008).

Table 3. Aloes used for health food and cosmetics (Young In and Hyung, 2006)

Species	Major component	Usage
Aloe barbadensis Miller (Aloe vera)	Gel extract, polysaccharides, glycoproteins and saponins	Raw material for functional foods and cosmetics
Aloe aborescens Miller	Processed whole leaves, anthraquinones and polysaccharides	Health food, peptic and laxative
Aloe saponaria Miller	Processed whole leaves, polysaccharides and glycoproteins	Raw material for functional foods and cosmetics

9. Various Utilizations and Compounds of Aloe Vera

Aloe Vera is an herbaceous and perennial plant with long thick fleshy leaves that belongs to the Liliaceae family and is similar to cactus in appearance. So far, 75 known compounds are found in Aloe Vera which contains 20 minerals, 20 amino acids, vitamins and water. Among them copper, iron, calcium, zinc, manganese, sodium, potassium, salicylic acid, vitamins A, B, C, E, B12 and folic acid can be pointed out. In vitro studies and in studies that have been conducted on living organisms it has been shown that Aloe Vera inhibits thromboxane (an inhibitor of wound healing), helps healing and reduces inflammation. Magnesium lactate in Aloe Vera gel prevents the reaction of histamine, which causes itching and irritation to skin. It also enhances the immune system activity and synthesis of the cytokine. By inhibition of IL-6 and IL-8 Aloe Vera reduces the adhesion of leukocytes, increases the levels of IL-10 and decreases the levels of TNF alpha, so it is effective in inhibiting inflammatory reactions. Its regenerative property is related to a compound called Glucomannan which is rich in polysaccharides such as mannose that effects on receptors of the fibroblast growth factor and stimulates its activity and proliferation and increases collagen production (Hekmatpou et al., 2018).

It contains 75 potentially active constituents, including polysaccharides, anthraquinone, lectin, superoxide dismutase, glycoprotein, vitamins C and E, salicylic acids and amino acids. Traditionally, Aloe Vera has been used topically in cosmetic products and herbal remedies in treatment of a range of inflammatory skin diseases for its anti-inflammatory, analgesic, wound healing, scavenging free radicals, antiproliferative, anticarcinogenic and anti-aging properties. It is believed that Aloe Vera exerts its anti-inflammatory effects through suppression of cyclooxygenase-2. It has also been used successfully for thermal burns, traumatic surgical wounds, radiationinduced dermatitis and skin ulceration. Although the mechanism of action by which Aloe Vera might facilitate healing is not clearly delineated, one hypothesis is that it exerts its effects as a result of antioxidant and immunomodulatory properties, and cyclooxygenase-2 suppression. One of active compounds in Aloe is salicylic acid, which can be converted into salicylate and thereby inhibits prostaglandin synthesis and the resulting inflammation (Sahebnasagh et al., 2020).

Aloe Vera leaves contain anthraquinones, saccharides, vitamins, amino acids, minerals, enzymes, fatty acids, other emollient, healing, clotting, moisturizing, antiallergic, disinfectant, anti-inflammatory, astringent, choleretic, laxative, and other compounds. Currently, the two most important components of Aloe Vera leaves (latex and pulp) are studied in several research centers worldwide as regards their use by different ethnic groups and to determine the mechanisms of action of the compounds contained within them. Latex, which is yellow and has an unpleasant odor, is also called leaf exudate, bitter sap, blood, or juice and is rich in phenolic compounds - mainly chromones, anthraquinones, and anthrones with particular therapeutic effects (Imery-Buiz, 2012).

10. Aloe Vera Extract in Patients with Diabetes

Hypoglycemic properties of Aloe Vera have been reported for years, few human studies have been carried out so far. Most of these studies have been implemented on patients with diabetes while some of such studies suffered from methodological weaknesses. In models of type I diabetes laboratory animals, it is shown that Aloe Vera extract had a similar effect on blood glucose to that of glibenclamide. Even in patients who did not respond to glibenclamide alone, consumption of Aloe Vera extract for 2 weeks could reduce fast blood glucose. Other studies have also shown the effectiveness of Aloe Vera extract on the regulation of blood glucose levels in diabetic animals. Few studies have indicated a rise in blood sugar levels after consumption of Aloe Vera extract which might be related to the use of different parts of the plant (not the gel) or short duration of the intervention (2 times a day for 3 days). Use of Aloe Vera extract in pre - diabetic patients can significantly regulate levels of fast blood glucose within four weeks and revert the levels of lipid profile, within eight weeks. It could be an interesting supplement strategy to alleviate impaired serum glucose level and lipid profile (Alinejad-Mofrad et al., 2015).

11. Aloe Vera Cream

Three researching articles identified Aloe Vera which is managed into the form of cream. Researching was found using cream of Aloe Vera Oil (AVO cream) toward wounds recovery with results with significant improvement results using pain assessment tools (VAS), AVO cream efficacy statistical test scores increased significantly.

It identified the effect of Aloe Vera cream 0.5% in chronic anal fissure treatment and it was found that using Aloe Vera cream could reduce pain and accelerate the process of wound healing during chronic anal fissure treatment. It also identified the using of Aloe Vera cream into reduce pain and accelerate the process of post-surgery wound healing, post defection (hemorrhoidectomy) and found that Aloe Vera cream significantly reduced post-surgery pain at 12, 24, 48 hours and 2 weeks post-surgery and patients who is receiving Aloe Vera cream has decreased when take number two significantly at 24 and 48 hours after hemorrhoidectomy and Aloe Vera cream significantly helps wound healing to post surgery patient during 2 weeks (Rozani and Kusbaryanto, 2019).

In other clinical studies, topical Aloe Vera was compared to silver sulfadiazine or Vaseline gauze in treating burn wound. The average time of healing reduced significantly in Aloe group. Aloe Vera cream has been also applied post-hemorrhoidectomy for ameliorating pain and recovering epithelial in order to accelerate wound healing. Seborrheic dermatitis is an inflammatory skin disorder with high prevalence. Aloe Vera extract has been shown to be effective in this dermal condition, too. Aloe extracts has proven antioxidant activity which protects against ROS-induced membrane and cellular damage (Sahebnasagh et al., 2020).

12. Aloe Vera Juice and Gel

A colorless mucilaginous material (gel) is stored within the leaf (hydroparenchyma, pulp, or glass) that contains glycoproteins, lectins, and large quantities of polysaccharides, including acemannan (rich in mannose)—one of the most important for the food, cosmetics, and drug industries (Imery-Buiz, 2012).

Aloe Vera gel is a constituent of food and drink, an anti-inflammatory in cosmetics and topical agents, and a moisturizer in lotions. Although experimental studies and anecdotal case reports suggest a wide range of medical applications for Aloe Vera gel, the clinical effectiveness of the oral or topical application of this substance remains unsubstantiated. The dried latex form of Aloe is an approved oral agent based on the cathartic actions of Aloe - emodins and other anthraquinone compounds. The plant portion most commonly used by the pharmaceutical industry is the latex, which stains clothes and fixtures purple (Barceloux, 2008).

All the results of researching prove that Aloe Vera is very useful for used to wound healing process. Aloe Vera gel topical using is done by application it to skiing as medicine for skin conditions such as burns, psoriasis, wound and can be taken orally (through mouth) for conditions including osteoarthritis, intestinal disease, fever. Pharmacological action of this get has assessed through in vitro and in vivo experiments. Preclinical researching results provide evidence that Aloe Vera has activity as anti-inflammatory, antirheumatic, anti-bacterial, and hypoglycemic. Health benefits Aloe Vera include the application in wound healing process, treat burns and given to protection against skin damage from Aloe Vera is a plan that can produce X-rays. Aloe Vera barbadensis gel combined and tongue protector it was found that using of Aloe Vera gel and tongue protector can reduce duration of wound healing to burning mouth syndrome patients. Others researching that reduce pain score and wound size but also accelerates the healing of alpthous stomatitis wound (Rozani and Kusbaryanto, 2019).

Aloe Vera gel not only increases the amount of collagen in wounds, but also changes the composition of collagen by increasing the collagen crosslinking and thereby accelerates healing of the wound. Studies show that since 99% of Aloe Vera gel is water, it can increase the flexibility of skin and reduce its fragility. Also, the muco-polysaccharides along with amino acids and zinc in Aloe Vera help skin integrity, retain its moisture, reduce erythema and help prevent skin ulcers. Many studies have shown that using Aloe Vera to treat various wounds such as psoriasis, mouth ulcers, diabetic ulcers herpes and bed sores has had positive effects. Given that the care of pressure ulcers is one of the important and challenging issues in medicine and nursing and prevention of ulcers is one of the main tasks of nurses which is also cost-

effective, on the other hand, the use of traditional medicine and herbal plants is one of the ways to prevent PUs and Aloe Vera has positive effects and benefits on the skin (Hekmatpou et al., 2018).

In one study, the use of oral administration of Aloe Vera leaf gel extract for 21 days improved glycoprotein metabolism in diabetic animal models. There is also evidence which shows that the glucose metabolism can be regulated with Aloe Vera. The plant has other properties such as the reduction of hepatic tissue damage resulting from diabetic complications in rats and reduction of the oxidative damage in the hippocampus and cerebral cortex of mice with type 2 diabetes (Alinejad-Mofrad et al., 2015).

One researching has been identified combination of Aloe Vera juice and gel in oral symptomatic lichen planus treatment, the said by combining treatment juice and gel in symptomatic oral lichen planus treatment reduce the duration of pain (Rozani and Kusbaryanto, 2019).

Aloe Vera gel is applied externally to treat skin irritation (such as from insect bites), burns, psoriasis, wounds, radiation dermatitis and frost-bite. It is also frequently found in cosmetic preparations, usually at low doses. Internally, aloe 'juice' is taken as a general tonic to enhance the immune system and to treat constipation. Aloe has also reported antidiabetic, anticancer and antibiotic properties. Aloe plants also yield a resinous exudate known as 'aloes' or 'bitter aloes', which is rich in anthraquinones and a strong laxative. These preparations are no longer recommended due to their potential genotoxic and mutagenic effects. External use of Aloe Vera gel appears to be safe, but there is limited data available on its safety for internal use. Large doses and long-term use should be avoided due to risk of nephritis (kidney inflammation), and studies in mice and rats have indicated genotoxicity and carcinogenicity. Aloe has been demonstrated to lower blood glucose and lipid levels in diabetic patients with hyperlipidemia and patients with metabolic syndrome (Edwards et al., 2015).

13. Aloe Vera in Prevention of Acute Radiation-Induced Proctitis (ARP)

In an experimental study, Aloe Vera did not alter the erythema or vasodilation produced by UVB radiation up to 24 hours after exposure. Clinical trials did not demonstrate the efficacy of Aloe Vera gel for the treatment of radiation burns or aphthous stomatitis (Barceloux, 2008).

Aloe Vera ointment was superior to placebo in prevention of acute radiation-induced proctitis (ARP) in patients during radiotherapy (RT). It prevented the symptoms of radiation- induced proctitis, especially diarrhea, hemorrhage, and fecal urgency. Aloe Vera also decreases the burden of systemic inflammation and enhanced quality of life of patients without causing significant adverse event. The results of this study are so promising, suggesting the use of this natural product for prevention of ARP in patients undergoing RT. In addition, this medicinal herb has been successfully used in treatment and alleviating acute radiation-induced proctitis (ARP) symptoms in patients receiving radiotherapy (RT). Aloe Vera mouthwash has shown promised efficacy in prevention and alleviation of radiationinduced mucositits in head and neck cancers without marked side effects. In previous clinical studies, a significant number of patients with chronic radiation proctitis seemed to benefit from combination anti-oxidant therapy of Vitamin C and E with sustained improvement in their clinical symptoms for as long as 1 year (Sahebnasagh et al., 2020).

14. Aloe Vera Solution to Stomatitis and Pain Intensity

Mansouri et al. (2016) using Aloe Vera solution to stomatitis and pain intensity in patient who undergoing chemotherapy procedures and the results were obtained that using of Aloe Vera solution to reduce the pain of chemotherapy to stomatitis patients are very effective with statistical test results on third day (on the 3rd day) - 14th day P=0.001 (stomatitis intensity) and P=0.001 (pain intensity).

Pain is common symptoms of many medical problems, which indicates tissue damage. Pain has several types such as acute pain, chronic pain, migraine, musculoskeletal, post-surgery pain, neuropathic pain, etc. One of causes of pain is wound caused by various health problems. Most researching literature reviews that discuss the using of Aloe Vera therapy through skin. Skin is one of organs as a protector which has function as a receiver regulate humidity, temperature modulation. It identify ways to speed the wound healing process and reduce intensity of paint from various health problems with treatment using Aloe Vera. But we can the type or form of Aloe Vera which given in the treatment is gel, cream, solution, juice and oil which given through skin. Only one researching investigates treatment with using Aloe Vera in a type of solution in stomatitis done by gargling. Whereas it is known that one of the most effective absorption of drugs through skin is solution and liquid. Aloe Vera functional to speed up the healing process of wounds into reduce the intensity of pain in the treatment of oral lichen planus, stomatitis, diabetes mellitus, pressure ulcers, venous ulcers, chronic anal fissure, heal burns, burning mouth syndrome, aphthous minor, operation post. So that could be said that the content of Aloe Vera has function to speed up the healing process of wounds and could reduce the intensity of pain which is due to several health body problems. Aloe Vera speeds up the healing process of wounds and reduces the intensity of pain which one Aloe Vera gel was encapsulated in liposome was used in the healing melasma process. Because the content Aloe Vera gel has function as a skin pigmentation modifying agent (Rozani and Kusbaryanto, 2019).

15. Utilizing Aloe Vera Waste (AVW)

During the extraction of Aloe Vera gel from leaves of this plant, a substantial proportion of Aloe Vera waste (AVW) is produced. The AVW is a great environmental concern for its disposal; however, it is rich in various bioactive compounds, which could be valorized as an ingredient of feeds in dairy cattle to reduce enteric methane production and consequently carbon footprint of milk production. Aloe Vera waste (AVW), a residue of Aloe Vera gel-producing industry, decreased methane production in vitro. Inclusion of AVW enhanced organic matter and fiber degradability and volatile fatty acid concentration in vitro. Feeding of AVW (20 g/kg diet) to lactating cows decreased methane production, yield and intensity. Feeding of AVW increased milk production and improve immunity in lactating cows. Feeding of AVW to lactating cows could decrease carbon footprint of milk production.

In a study, revealed milk production increased due to feeding of AVW. In vivo nutrient digestibility and concentrations of fat, protein, and lactose in milk were not affected, but yields of these milk components increased due to AVW feeding. Supplementation of AVW significantly decreased methane production (g/day), methane yield (g/kg dry matter intake or g/kg digestible organic matter intake), methane intensity (g/kg milk production) or methane conversion ratio. Feeding of AVW improved delayed type of hypersensitivity without affecting other blood variables adversely. Also this study demonstrates that feeding of AVW at 20 g/kg dry matter intake to dairy cows increased milk production and decreased methane production, which combined decreased methane production per unit of milk production substantially without health effects. Thus, feeding of AVW could be beneficial for sustainable and cleaner milk production decreasing environmental burdens of residue disposal problems and ruminal methane production (Singh et al., 2021).

16. Botanical and Ecological Features

Aloe Vera is a perennial herb, without apparent stems (stem less) in plants under 5 years old. In large populations more than 50 years old, there are adult plants with creeping rhizomes almost 40 cm long and 6–7 cm in diameter. A small stem can be distinguished in cultivated plants whose leaves have been harvested from the base, leaving an uncovered section of 1.6 cm per year. In these plants, the stem is wrapped with thin ochre-colored layers, formed from the remains of the dried leaf ligules covering the compact sand-colored internodes. The beige lateral buds are aligned in tight, light brown knots below the ligule. From these the stem meristem generates stolons 6–11 mm in diameter and of variable length that grow and emerge from the soil in the form of suckers close to the mother plant. The main root may be distinguished by its darker color (brown to coffee), absence of sheaths, and emission of secondary roots of the same color at their base, which become lighter along their length and are yellowish at the apex (Imery-Buiz, 2012).

17. Drought Conditions and Necessity for Development Greenhouses in Iran

Information pertaining to a decrease or increase in the amount of rainfall have significant effects on agricultural and municipal water management, especially in arid and semi-arid countries like Iran. Although some climatic parameters have been shown to have a distinct trend globally (a positive trend for temperature, for example), rainfall behavior varies depending on the location. Since rainfall is the most important source of water for all agricultural requirements, information about rainfall trends is valuable to policy makers (Ghahraman and Taghvaeian, 2008).

As a result, precipitation pattern including rain and snow will change. Other facts and projections show, warm and dry regions will become warmer and drier (Masoudi et al., 2018).

Arid and semi-arid zones are very sensitive and vulnerable to the climate change impacts. Vulnerability to climate change and other hazards constitutes a critical set of interactions between society and environment. The central Asia is particularly vulnerable due to physical geography, which dominated by temperate deserts and semi deserts. Aridity is expected to increase across the entire Central Asian region. Temperature increases are projected to be particularly high in summer and fall, accompanied by decreases in precipitation.

I.R of Iran is located in the North Temperate Zone which lies between the latitudes of 25° 14’ and 39°42' N and the longitudes of 44° 10' and 63° 11' E with a total area of approximately 1650000 square kilometers. Elevations range from 26 meters below sea level on the shores of the Caspian Sea to 5671 meters above sea level at the pick of the Mt. Damavand. Drought is one of the most critical factors in Iran. About 50 % of Iran can be classified as arid or semi-arid zones. The average precipitation of the country is 245 mm per year. Climate parameters, particularly precipitation varies significantly in different parts of the country. There is not a good annual rainfall distribution in most regions of Iran. Not only high temperature in southern, central and lowlands of Iran is a limiting factor, but also low temperature in northern, western and highlands is another limiting factor too. As a fact which Iran is located on dry belt of earth and importance of its vegetation cover and forest ecosystems and also limited of adequate research on climate change, consideration of past climate changes and investigation on future climate projection play an important role in development programs. In the South Khorasan Province, a greater portion of land during last decade became warmer than before. This confirmed the overall global warming in the world. Furthermore, those areas showing decreasing in precipitation during the

time were more widespread compared with those areas without any changes. The results derived from the trends of climate index confirmed this fact that the overall climate of the province became worse because more than 76% of the lands showed that the region goes to the drier condition. The hazard classification for climate change was used in the research can be used in the other Places. Unfortunately, the results based on this classification indicated that the areas under very severe and severe hazards cover all parts of province showing need more attention to this part of country and doing related remedial measures like current project of carbon sequestration (Masoudi et al., 2018).

According to latest report that published by National Drought Warning and Monitoring Center (NDWMC) in the In year 2020 – 2021 the average amount of rainfall in country determined 127.1 mm that it means it is very lower (about 50 percent) lower from the long run average precipitation of the country that is 215 mm per year (National Drought Warning and Monitoring Center, May 2021).

In this regard, development and extension greenhouses in desert regions of Iran has been considered as a critical and important approach by government for improving efficiency and efficacy of water utilization in agricultural sector of the country. Aloe Vera greenhouses in these disadvantaged, isolated and dried regions of Iran namely South Khorasan and Semnan provinces with very bad desert conditions can improve situation of productivity and employment in them.

18. Aloe Plants and Iranian Traditional Medicine (ITM)

Iranian Traditional Medicine (ITM) is rich in intact information about plants that have been used to treat various diseases, especially skin disorders. Herbal drugs have been used worldwide in traditional medicine for treatment of various diseases. World plant biodiversity is the best source of herbal medicine and still about 60%-80% world population trust on plant based medicines which are being used since the ancient ages as traditional health care system (Jahandideh, 2016).

The diversity of plant species in Iran can be observed due to the variety of weather conditions that might provide the availability of more natural pharmaceutics and poison plants to people throughout the country. Application of plants is a very ancient medicinal treatment. Thousands of plant species grow in Iran with different kinds of pharmaceutical properties. The only species of Aloe Vera that can grow in Iran is A. littoralis baker that is seen in the southern area and islands of the Persian Gulf. Aloe inner gel is the colorless gel consisting primarily of water and polysaccharides, including pectin, cellulose, hemi cellulose, glucomannan, acemannan and mannose derivatives. Acemannan is considered to be the main functional component of Aloe Vera and is composed of a long chain of acetylated mannose. Among the health benefits of Aloe Vera leaves the acceleration of ulcer healing, immune stimulating, antiviral and anticancer effects can be mentioned (Safari et al., 2019).

Aloe (*Aloe littoralis*) is important clinically and economically. This plant is native in Iran and natural and traditional of proliferation is very slow, in the result, needs of medicinal industry do not prepare. Aloe (*A. littoralis*) can proliferate from micropropagation technique rapidly (Bayani et al., 2019).

19. Modern Application and Industrialization of Aloe

Modern application of Aloe in clinical treatment started in the 1930s. After the curing effects of Aloe Vera on skin ulcers caused by X-ray irradiation were first proven by modern scientific methods, many studies have been conducted for the treatment of various skin diseases such as ulcer, inflammation, and burning caused by X-ray irradiation. With the development of nuclear power, the United States government conducted research on the curing capabilities of Aloe Vera on heat and radiation burns in order to introduce its use in the military. In addition the research on Aloe Vera was accelerated in 1952 when a Japanese boat was contaminated by passing through the US Bikini Islands during a hydrogen bomb test. The US government procured medication using Aloe Vera to treat the radiation burns that the sailors suffered from the irradiated dust. After this incident, scientists became interested in research on the ingredients of aloe which expressed those effects other than anthraquinones as a laxative. After aloe ointment was recognized as an OTC medication for healing wounds on the skin by the USFDA in 1959, extensive research on clinical properties was conducted in terms of its pharmacological and treatment effects. Aside from its ability to heal skin wounds, Aloe Vera has also been proven to cure oral infections and diseases related to the gums. In addition, it has also been verified that Aloe Vera can be clinically applied to chronic ulcers on the foot, can stimulate growth of normal human cells by its lectin, and can cure skin burns and even frostbite (Young In and Hyung, 2006).

Based on these findings, the production of Aloe (especially Aloe Vera) has been industrialized over the last 50 years by growing and processing in large quantities for OTC medications, health foods and cosmetics. Accordingly, mass cultivation and processing technologies have also been developed. Many technological improvements have been achieved such as the High Temperature Short Time (HTST) method for hygienic preparation of the gel, technology for the stabilization of the gel concentrate without destroying the effective components, and the improved freeze drying method or spray drying method to preserve the quality of the gel extract as much as possible. As such, aloe as a raw material has been produced massively and made easily available. However, despite this expansion in

production and various research papers, the development of more specialized and professional medications has lagged well behind, presumably because the excessive commercial mentality of company leaders. Instead of investment in R&D for new products based on the spearhead scientific technology, they have been simply relying on improvements of traditional methods to boost productivity in a strictly commercial manner. In this regard, aloe was simply treated as a cure for all injuries and diseases by these company leaders, which led to criticism from scientists and the perception that aloe is a traditional, homemade medicinal ingredient and nothing more. For example, companies advertised that aloe was used as a panacea by King Alexander or Queen Cleopatra, which simply increased the level of distrust for aloe among the potential customers (Young In and Hyung, 2006).

Two substances from Aloe Vera – a clear gel and its yellow latex – are used to manufacture commercial products. Aloe gel typically is used to make topical medications for skin conditions, such as burns, wounds, frostbite, rashes, psoriasis, cold sores, or dry skin. Aloe latex is used individually or manufactured as a product with other ingredients to be ingested for relief of constipation. Aloe latex may be obtained in a dried form called resin or as "aloe dried juice".

There is conflicting evidence regarding whether Aloe Vera is effective as a treatment for wounds or burns. There is some evidence that topical use of aloe products might relieve symptoms of certain skin disorders, such as psoriasis, acne, or rashes.

Aloe Vera gel is used commercially as an ingredient in yogurts, beverages, and some desserts, but at high or prolonged doses, ingesting aloe latex or whole leaf extract can be toxic. Use of topical aloe Vera in small amounts is likely to be safe (Jamshidi et al., 2018).

Aloe Vera may be prepared as a lotion, gel, soap or cosmetics product for use on skin as a topical medication. For people with allergies to Aloe Vera, skin reactions may include contact dermatitis with mild redness and itching, difficulty with breathing, or swelling of the face, lips, tongue, or throat.

20. Materials and Methods

Main locations of doing this study were greenhouses of Aloe Vera in two provinces of Iran, namely South Khorasan Province, east of Iran (especially, first rank of doing this study) and Semnan Province, in the north of the country (second rank of doing this study), because of accessibility of them for researcher. Plus above, author also utilized pictures, documents etc. of its open farming in other provinces of Iran (Figure 4).

In Figure 4 map, shows locations of doing this study as A and B. For doing this study utilized qualitative approach with its main tools for gathering information such as participatory observation, maps, scientific articles, pictures, documents (Iranian and foreign scientific magazines and journals, TV and radio programs, Iranian Bureau of Statistics), discussion with experts, professors and beneficiaries and field research specially in above two provinces.

Figure 4. Map locations of doing this study, A (South Khorasan Province, east of Iran) and B (Semnan Province, in the north of the country) (Iranian Bureau of Statistics, 2021).

As Creswell (1994) noted in a qualitative study, one does not begin with a theory to test or verify. Instead consistent with the inductive model of thinking, a theory may emerge during the data collection and analysis phase of the research or be used relatively late in the research process as a basis for comparison with other theories.

South Khorasan Province located in the east of Iran with a total area of 15,030120 ha and mean annual temperature of 17.5°C and precipitation of 134 mm, which lies between the latitudes of 30° 31' and 35°05' N and the longitudes of 55° 22' and 60° 55' E.

Semnan Province covers an area of 96,816 square kilometers and precipitation of 120 mm, and stretches along the Alborz mountain range and borders to Dasht-e Kavir desert in its southern parts (National Drought Warning and Monitoring Center, May 2021) and (Iranian Bureau of Statistics, 2021).

21. Results

In this section of study discussing various aspects, situations and problems of cultivating Aloe Vera greenhouses and their economic importance in South Khorasan and Semnan provinces in east and north of the country. After gathering information following results achieved and classified in cultivating Aloe Vera greenhouses in South Khorasan and Semnan provinces as below:

Aloe Vera is a very resistive plant to dried conditions and water shortages. Its period time for irrigation is one time in each 12-15 days that it is dependent to soil texture and degree of temperature. In spring and summer seasons irrigation occur when the soil dried completely, except

this one, irrigation cause decay in the stems of Aloe Vera.
Aloe Vera can grow in each types of soil textures but light soils that have drainage are better and preferable for growing of plant. It is better that greenhouse has a proper and light slope of soil for removing ponded water from roots of the plant and also re-usage of this water.
Best type of fertilizers for this plant is decayed wastes of animals. Adding coarse materials such as sand cause lightening and alleviating soil texture and improving exchange of air and water for plant. The most ideal type of soil texture for Aloe Vera cultivating is soils with loamy texture.
In the first year of Aloe Vera planting, farmers harvesting its leaves in each four months. But from the second year in each season (three months) its leaves can be harvesting. Amount of harvesting leaves in each time is between 16-22 tons in one ha. Aloe Vera die in under zero degree centigrade and can alive until 55 degree centigrade. Best proper temperature for growing this plant is between 15- 30 degree centigrade. Each leaf of Aloe Vera in time of harvesting has 500 - 1000 g weight and they must have enough gel for supplying to market. Its amount of gel is dependent to degree of plant maturing and meeting plant nutritional needs. Each shrub can produce 4-6 kg matured leaves and it possible 2-5 times of plant harvesting each year.
High degree of sunlight intensity cause change color of leaves from green to brown. Best quality in production of plant leaves achieve by medium degree of sunlight intensity. Best type for irrigation is tube irrigation, but we can also utilize Crete and drop irrigation types. Plant reproduction of Aloe Vera can be done by seeds, tissue cultures and offshoots (underbrush), but the best type is utilizing offshoots (underbrush) that have life time between 5-8 months and height between 20-25 cm (Figure 5).
Each offshoots)underbrush) after transferring to destination land will enter to plant recession period for 45 – 90 days and all of their gels will empty and consume for plant. After this time, if meeting plant nutritional needs and preparing good temperature etc. properly, plant can produce leaves with enough and good gels in 9 months later.
The most important problem of greenhouse owners is marketing difficulties for their productions. The prices for Aloe Vera leaves in market are very below and this cause producing of this plant is uneconomical and nonprofit for many of them and some of them bankrupt and exit from production cycle. Also there aren't enough side and processing industries of Aloe Vera in these regions and only one factory of processing Aloe Vera to powder available in Gonabad city in Khorasan Razavi Province with 220 km distance to Birjand. Its majority of powder production export to foreign especially Russia. These production problems are also confirmed in the whole of the country in: (Lahsaeizadeh, 2007).

Figure 5. Utilizing offshoots (underbrush) for propagation of Aloe Vera. In a greenhouse with 15 km distance to Birjand, center of South Khorasan Province, east of Iran (By author; Spring, 2021).

22. The Situation of the Aloe Vera in the World (Fields Grown, Export and Import)

There are different statistics from various institutions in these regard that point them as following:
The global Aloe Vera extract market size is projected to reach US$ 1897.8 million by 2026, from US$ 1473.4 million in 2020, at a compound annual growth rate (CAGR) of 4.3% during 2021-2026. (Research Reports, 2020). The global Aloe Vera market is expected to grow at a CAGR of around 7% during 2021-2026. The global Aloe Vera market was worth US$ 602 Million in 2019. The global Aloe Vera market is expected to reach US$ 915 Million by 2025, growing at a CAGR of 8.60% during the forecast period (2020-2025).
The utilization of Aloe Vera in the production of personal care products, like face wash, toners, face packs, creams and body lotions, is one of the significant market drivers. With the rising health-consciousness, consumers now prefer products containing natural ingredients, such as Aloe Vera, which are perceived to be safer and healthier than their processed or chemical alternatives. Due to the outbreak of the coronavirus disease (COVID-19), lockdowns have been imposed by governments of numerous countries. This has led to a temporary shutdown of various manufacturing units, thereby negatively influencing the market.
The market has been categorized into concentrates, gels, drinks, powders and capsules. Amongst these, Aloe Vera is mostly consumed in the form of drinks. On the basis of the application, Aloe Vera is mostly used in the cosmetic industry. Other major applications are the pharmaceutical and food industries. The leading market players are Forever Living Products (FLP), Herbalife International of America, Inc., Aloecorp, Aloe Laboratories, Inc., Terry Laboratories, LLC, Lily of the Desert, Foodchem International Corporation, and Pharmachem Laboratories, Inc. (IMARC Group, 2021).
According to IMARC Group, the global Aloe Vera gel market was worth US$ 465 Million in 2016, growing at a CAGR of around 11% during 2009-2016. The market has been growing steadily over the last decade driven by varied and increasing usage of Aloe Vera gel in food,

health care and cosmetic industries (Reportlinker, 2017). The market has been growing steadily over the last decade driven by varied and increasing usage of Aloe Vera in the food, health care and cosmetic industries. The healthcare and cosmetics sectors are currently the two biggest drivers of Aloe Vera consumption. Region-wise, Thailand was the biggest producer of Aloe Vera accounting for around a third of the total global production. Other leading producers include Mexico, Dominican Republic, United States and Costa Rica.

Aloe Vera has numerous benefits and finds its application in numerous industries such as food, beverages, cosmetics, pharmaceuticals, etc. Numerous studies have also found Aloe Vera to be beneficial in several indications such as teeth and gum problems, constipation, diabetes induced foot ulcers, antimicrobial properties, protection from UV radiation, skin problems, etc. Apart from the current uses, the benefits of Aloe Vera are also being studied in a number of several other indications. This is expected to further diversify the applications of Aloe Vera and create opportunities to launch several new products targeting newer indications.

As a result of a rising prevalence of lifestyle related diseases, consumers around the world are becoming more conscious of their health. Driven by this trend, the demand of products containing natural ingredients such as Aloe Vera are being perceived by consumers to be safer and healthier than their processed or chemical alternatives. This coupled by the numerous health benefits of Aloe Vera is expected to create a positive impact on its global demand. Another major factor driving the growth of the Aloe Vera market is its strong consumer acceptance.

Although the demand of Aloe Vera is strong throughout the globe, growth rates in emerging markets such as India, China, Middle East, etc. are expected to be extremely high. Driven by rising economic growth, increasing disposable incomes and low market penetration levels, emerging markets are expected to represent major drivers of future growth. (IMARC Group, 2021). Unfortunately, there aren't precise statistics on extent of farms that cultivating Aloe Vera in the world. In previous, state extent of this in some provinces of Iran.

23. Discussion and Conclusion

Aloe Vera is a medicinal plant used since ancient times and cultivated in many warm regions of the world. A large amount of active ingredients and therapeutic properties are known in Aloe Vera however, research for genetic improvement is recent and limited by the form of vegetative propagation. The low genetic variability of Aloe Vera has been overcome with the practice of hybridization assays using species that have high medicinal value. Moreover, the exploitation of polyploidy has played an important role in improving foliar biomass production and tolerance to diseases. The combination of these two breeding strategies has allowed us to explore an important source of genetic variation accumulated by the asexual reproduction of Aloe Vera and donor species, in addition to contributions to the variability that have contributed in each parent recombination and chromosome mutations that occur throughout the formation of sex cells (Imery-Buiz, 2012).

Aloe has been variously used for civilian and traditional medical purposes worldwide for thousands of years, and today it remains in use as a self-medication in western and under-developed countries. As such, aloe's possession of various functions has been clinically proven. It is truly one of the very few plants that are used in such a profusion of applications (Young In and Hyung, 2006).

With polyploidy, hybridization, and even artificial mutations, a lot of experimental genotypes offer a promising future in the field of traditional breeding of Aloe Vera. The application of new technologies has also offered alternative horizons for the improvement of Aloe Vera achieving successful propagation and maintenance of tissues in vitro conditions and the production of transgenic plants via agrobacterium transformation. This background envisions the integration of multidisciplinary groups to achieve significant advances in breeding, cultivation and use of therapeutic benefits of Aloe Vera (Imery-Buiz, 2012).

Following points can be considered as the most important advantages of cultivating Aloe Vera greenhouses in desert regions of Iran plus approaches for their development, extension, processing and marketing:

- This plant doesn't need to rich and fertile soils plus its high degree resistance to salinity of soils and water.
- It has a huge amount of economic advantage for cultivating in small farms and greenhouses with utilizing labor force of family.
- Its cultivating doesn't need to high degree of knowledge in management and agricultural sciences.
- Its water need is very low in comparing to other greenhouses plant such as tomato, cucumber etc. it is estimated its water consumption is 20 percent of tomato, cucumber etc.
- Its high degree resistance to heat and bad air conditions in the limit of 50 degree of centigrade and it has very low need to thermo genic devices and thus its low consumption of fuel and energy in comparing to other productions and thus reducing fuel and energy in large scale in country.
- Its high degree resistance to pests and plant diseases.
- It doesn't need to replant for many years in comparing to other greenhouse productions.
- It needs to very low primary investment for establishing its simple greenhouses plus this important point that its greenhouses don't need to many infrastructures such as asphalt roads, high voltage electricity (three phase electricity), gas

network optimization, etc.

- Returning primary investment for establishing its greenhouses during less than three years.
- Increasing various utilizations of Aloe Vera in different sectors of society such as health, nutrition (drinks, foods etc.), medicines, cosmetic and toilet etc. industries. This important point must be considered that with very researches that in Iran and world are doing on Aloe Vera, we will see more and more utilizations of this valuable plant in above sectors in future and therefore demand for Aloe Vera will increase in Iran and world in future permanently.

In present, drought and decreasing water resources, land use changes in farms and rural areas, and fragmentation in agricultural lands are most important problems and challenges in agriculture sector of Iran. In this order development greenhouses can be consider as one of the most important solutions in order to confronting to above problems and providing appropriate field for employment in this sector especially for youth people that have academic degrees and graduated in agricultural sector of Iran.

Author during his research with owners of greenhouses found that Aloe Vera can grow in any type of soil with low consumption of water and can adapt with different types of soil and water and thus is a very good option for greenhouses cultivating in desert regions of Iran. Many of agricultural productions have a short, distinguished and limited time for their production and consumption, but their consumption time is very longer and development side and processing industry of agricultural productions can provide conditions and creating positive changes. Processing in these productions allow people consuming them along the year.

Weakness in the field of processing Aloe Vera and development side industry and processing industry of Aloe Vera caused that many farmers avoiding from entering in domain of cultivating this valuable plant. This valuable plant after harvesting in above industries must change and processing to gel, cream, powder, drinking, foods etc. and this important work needs investment by privacy sector and government.

Development side industry and processing industry of Aloe Vera in these regions of Iran can increase amount and value of production, reducing costs and wastes of production, reducing permanent and seasonal unemployment among rural people, providing an appropriate field and context for regional development of agriculture employment opportunities, securing basic needs of local people, connection with other economic sectors, and reducing regional inequality etc.

Because of above, governors and strategic decision makers must be consider development side industry and processing industry of agricultural productions (especially in Aloe Vera) as a key approach for accessing to industrialization strategy of the country and accessing to food security.

Author Contributions

All task made by single author and the author reviewed and approved the manuscript.

Conflict of Interest

The author declared that there is no conflict of interest.

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Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.998526

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 5 - Issue 1: 16-20 / January 2022

DETERMINATION OF THE EFFECT OF ZEOLITE AND ORGANIC ACID MIXTURE SUPPLEMENTATION IN THE LAYER DIET ON PERFORMANCE AND EGG QUALITY USING GREY RELATIONAL ANALYSIS METHOD

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Abstract: Grey system theory is a method used when the assumptions of homogeneity of variances in the application of parametric statistical methods of analysis, the assumption that the distribution of data to be applied is appropriate to the normal distribution and that it is, for example, of sufficient size. Grey relational analysis is one of the subtitles of the grey system theory and it is a method of grading, classification and decision making in the data set using the Grey Relation Coefficient (GIA). In this study, the effects of addition of zeolite, organic acid and zeolite-organic acid added to the rations of twenty-four Lohmann LSL type white-laying hens at 28 weeks of age on the quality and performance of eggs were examined. Grey relational analysis was applied to egg quality and performance criteria. It was found that the highest quality eggs were added with organic acid (P) additions to the chicken rations (P6, P3, P1), and the K1 in the control group and the (Z + P) 1 sample in which the zeolite and organic acid additives were applied together were also found in the quality egg group. In terms of quality, middle class egg samples were determined to be zeolite additive group and low quality egg group was found to be control and zeolite + organic acid added group.

Keywords: Grey relational analysis, Performance, Egg quality, Zeolit, Organic acid

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Received: September 21, 2021
Accepted: October 07, 2021
Published: January 01, 2022

Cite as: Yağanoğlu AM, Topal M. 2022. Determination of the effect of zeolite and organic acid mixture supplementation in the layer diet on performance and egg quality using grey relational analysis method. BSJ Agri, 5(1): 16-20.

1. Introduction

The main purpose in animal production is to provide high income from farm animals in line with low costs (Kumlu 1999). The animals with the highest values in terms of productivity should be weeded out and the next generations should be formed from their offspring. In order to carry out the animal breeding studies successfully, it is necessary to obtain the data of the breeder candidates and their relatives and to determine the breeding values with the lowest error. The comparison of breeding values of individuals in line with the information obtained from different sources is possible with the use of the selection index. In animal breeding studies, the selection index value is one of the most important parameters used for the selection of animals.

In recent years, as a result of developments in mathematics, statistics and information technologies, different variance estimation methods such as analysis of variance (ANOVA), maximum likelihood (ML) and restricted maximum likelihood (REML) have been developed. Henderson (1984), with the spread of simple algorithms based on mixed model equations, the REML method introduced by Patterson and Thompson (1971) has become the most widely used method for estimating the variance elements of mixed models in animal breeding.

Grey system theory is one of the ideal methods that can be applied to the solution of these problems in cases where the information is little or discrete, as well as when the information is too much or uncertain. It is also an approach to multivariate statistics that helps to model uncertainties whose distribution is unknown and for which sufficient data set cannot be obtained (Üstünışık, 2007).

Mammedova and Keskin (2011) found that by using the characteristics of the cows' movement, whether they are active and the time elapsed after the last estrus, using the fuzzy logic method, the estrus can be detected correctly, and the estrus is detected at a rate that can be considered quite high, such as 98%.

Wade et al. (1998), in their breeding study, stated that as a result of the fuzzy model created by using the milk yield, birth interval and age parameters of the animal, it is easy to decide on the selection of animals with low milk yield, long birth interval and high age, but with higher milk yield and birth interval. They stated that it

would not be easy to make a decision for tall and very old animals. As a result, they stated that the method applied to determine which animal or animals will be removed from the herd is beneficial for animal husbandry.

According to Morag et al. (2001) developed a decision support system that determines the amount of concentrated feed that should be added to the rations of farm animals individually according to the performance (milk yield and body weight) of the farm animals, using fuzzy logic. The researchers, who showed that the decision support systems created using fuzzy logic can be used practically, stated that there is a 10% difference between the decisions made by the Decision Support Systems (DSS) and the decisions made by the expert, and this is not important.

2. Material and Methods

2.1. Animal Materials

The animal material of the study consisted of 24 Lohmann LSL type white layer hens aged 28 weeks, raised in the Poultry Branch of Atatürk University, Faculty of Agriculture, Agricultural Research and Extension Center.

2.2. Statistical Analysis

2.2.1. Grey relational analysis

Grey relational analysis is considered to indicate that black does not have information, white has information completely, and grey indicates the degree of information between black and white. In other words, it is based on the rule that some information is known and some is not known in the grey system. In the white system, the interrelationships within the system are certain, but not in the grey system (Tosun 2006).

Grey relational analysis is one of the sub-titles of grey modelling. This analysis method is a method for determining the degree of relationship between each factor in a grey system and the compared factor (reference series) series. Each factor is defined as an array (row or column). The degree of influence between the factors is called the grey relational degree (Üstünışık, 2007).

The steps of the grey relational analysis method are as follows;

Step 1: Formulate n reference series (Deng 1989) (equation 1).

$$x_0 = (x_0(1), x_0(2), x_0(3), \dots \dots x_0(n)) \quad (1)$$

Step 2: Normalization of data.

Normalization in case of "higher is better"; Kuo et al. (2008) (equation 2).

$$x_i(k) = \frac{x_i^0(k) - \min x_i^0(k)}{\max x_i^0(k) - \min x_i^0(k)} \quad (2)$$

Normalization in case of "lower is better" (equation 3);

$$x_i(k) = \frac{max\ x_i^0(k) - x_i^0(k)}{\max x_i^0(k) - \min x_i^0(k)} \quad (3)$$

Normalization in case of "better than ideal value" (equation 4);

$$x_i(k) = 1 - \frac{|x_i^0(k) - x^0|}{\max x_i^0(k) - x^0} \quad (4)$$

Step 3: The m series to be compared with the x^0 series are defined as follows; Zhu and Hao (2009) (equation 5).

$$x_i = (x_i(1), x_i(2), x_i(3), \dots \dots x_0(n)) \text{ i= 1,2,.....m} \quad (5)$$

Step 4: k, k in n series. $\varepsilon(x_0(k), x_i(\text{k}))$, k. The grey at the point is the relational coefficient and is represented by the formula below. Mao, et al. (2010) (equation 6).

$$\varepsilon(x_0(k), x_i(\text{k})) = \frac{\Delta_{min} + \xi\Delta_{max}}{\Delta_{0i}(k) + \xi\Delta_{max}} \quad (6)$$

$$\Delta_{0i}(k) = \left|x_0(k) - x_j(k)\right|$$

$$\Delta_{min} = min_j\ min_k \left|x_0(k) - x_j(k)\right|$$

$$\Delta_{max} = max_j\ max_k \left|x_0(k) - x_j(k)\right|$$

Step 5: grey relational degree coefficients are calculated; (Wu, 2007) (equation 7).

$$\gamma(x_0, x_i) = \frac{1}{n}\sum_{k=1}^{n} \varepsilon(x_0(k), x_i(\text{k})) \quad (7)$$

3. Results

Correlation coefficients (Table 1) are examined, haugh unit and white index (WI) (0.798), daily feed consumption (DFC) and egg production (EP) (0.728), daily feed consumption (DFC) and feed conversion ratio (FCR) (0.694)), yellow index (YI) and white index (WI) (0.606) and shape index (SI) and white index (WI) (0.520) were found to have a statistically significant correlation in the linear direction can be said to be affected. Shell thickness (KK) with haugh unit (0.468), shell weight (KA) with shell thickness (KK) (0.464), haugh unit with yellow index (SI) (0.445), white index (AI) with shell thickness (KK) A statistically significant linear relationship was found between (0.425) and shape index (SI) and crustal thickness (KK) (0.410), and an increase in any of these variables causes an increase in the other.

3.1. Results of Grey Relational Analysis Method

Table 2 is examined, when the averages of grey relationship degrees of egg quality and performance characteristics are taken into account, the quality and performance criteria for the sample data set are Haugh unit (0.736), shape index (0.645), feed conversion ratio (0.589), breaking strength (0.548), in order of importance egg production (0.546), egg weight (0.537), yellow index (0.520), white index (0.517), shell weight (0.508), daily feed consumption (0.504), shell thickness (0.489) are listed as. Among these variables, the grey

correlation coefficient averages of the Haugh unit, shape index and feed conversion ratio were found to be higher than the general average of the grey correlation coefficients (0.558), while the average of the other variables was found to be smaller than the general average. Therefore, these variables (Haugh unit, shape index and feed conversion ratio) can be taken as important quality characters in determining egg quality criteria.

Table 1. Correlation coefficients between quality and performance parameters

	EW	FCR	EP	DFC	BS	SI	ST	SW	WI	YI	Haugh
EW	1										
FCR	-0,229	1									
EP	-0,095	0,126	1								
DFC	0,102	0,694**	0,728**	1							
BS	0,091	0,150	-0,367	-0,103	1						
SI	0,246	-0,285	-0,024	-0,142	0,092	1					
ST	0,341	0,117	-0,365	-0,062	0,236	0,410*	1				
SW	0,213	-0,131	-0,207	-0,151	0,264	0,020	0,464*	1			
WI	0,252	0,021	0,068	0,126	-0,165	0,520**	0,425*	0,125	1		
YI	0,031	-0,111	-0,106	-0,128	-0,089	0,213	0,291	0,002	0,606**	1	
Haugh	0,289	0,196	0,188	0,337	-0,162	0,328	0,468*	-0,014	0,798**	0,445*	1

Table 2. Grey relation coefficients according to quality and performance criteria

Group	EW	FCR	EP	DFC	BS	SI	ST	SW	WI	YI	Haugh
K1	0.754	0.555	0.452	0.455	0.369	0.857	0.495	0.446	0.666	1.000	0.914
K2	0.486	0.521	0.576	0.429	0.401	0.462	0.432	0.476	0.407	0.333	0.525
K3	0.449	0.603	0.655	0.449	0.333	0.750	0.398	0.422	0.453	0.408	0.655
K4	0.368	0.333	0.559	0.367	0.486	0.750	0.451	0.429	0.337	0.379	0.644
K5	0.772	0.619	0.528	0.437	0.486	0.600	0.495	0.539	0.565	0.472	0.761
K6	0.368	0.596	0.792	0.452	0.391	0.462	0.357	0.351	0.643	0.548	0.887
Z1	0.462	0.737	0.792	0.456	0.484	0.500	0.415	0.449	0.590	0.446	0.832
Z2	0.600	0.608	0.559	0.445	0.484	1.000	0.415	0.394	0.445	0.475	0.752
Z3	0.600	0.471	0.352	0.533	0.484	0.375	0.750	0.474	1.000	0.651	0.995
Z4	0.368	0.348	0.792	0.333	0.540	0.750	0.472	0.574	0.699	0.650	0.929
Z5	0.506	0.640	0.404	0.591	0.544	0.857	0.451	0.393	0.352	0.479	0.468
Z6	0.333	0.965	0.371	1.000	0.615	0.667	0.333	0.444	0.333	0.482	0.333
P1	0.902	0.847	0.559	0.474	0.486	0.429	0.654	0.672	0.572	0.460	0.876
P2	0.589	0.532	0.433	0.483	0.515	0.333	0.580	0.476	0.612	0.737	1.000
P3	0.394	1.000	0.352	0.969	0.482	0.750	0.548	0.531	0.505	0.636	0.822
P4	0.479	0.496	1.000	0.352	0.599	0.545	0.451	0.364	0.468	0.639	0.823
P5	0.381	0.520	0.792	0.415	0.389	0.667	0.451	0.743	0.477	0.540	0.610
P6	0.531	0.851	0.333	0.834	0.670	0.667	0.548	1.000	0.499	0.489	0.763
(Z+P)1	1.000	0.582	0.559	0.396	0.708	1.000	0.398	0.782	0.393	0.415	0.529
(Z+P)2	0.506	0.439	0.458	0.435	1.000	0.600	0.432	0.556	0.545	0.452	0.656
(Z+P)3	0.531	0.419	0.404	0.454	0.993	0.462	1.000	0.560	0.464	0.446	0.695
(Z+P)4	0.394	0.342	0.392	0.448	0.680	0.857	0.451	0.427	0.468	0.466	0.743
(Z+P)5	0.600	0.744	0.559	0.488	0.553	0.545	0.370	0.333	0.471	0.457	0.777
(Z+P)6	0.522	0.369	0.432	0.401	0.455	0.600	0.383	0.367	0.446	0.410	0.679
Ort GRC	0.537	0.589	0.546	0.504	0.548	0.645	0.489	0.508	0.517	0.520	0.736
Rank	(6)	(3)	(5)	(10)	(4)	(2)	(11)	(9)	(8)	(7)	(1)

According to the results given in Table 3, the best egg sample according to the grey relationship in terms of quality and performance was found organic acid (P6) added to the chicken ration, while the lowest egg sample in terms of quality and performance was the combination of zeolite and organic acid (Z+P). The difference between the grey relation degree of the best egg sample (P6) 0.653 and the grey relation degree of the lowest (Z+P) 6 0.460 sample in terms of quality and performance (0.653-0.460) was 0.193, which is the standard value calculated over all samples. Since the deviation is higher than (0,172), we can say that there may be a difference in quality and performance between the best (P6) sample and the worst (Z+P) 6. In terms of quality and performance, five of the six samples (P1,P2,P3,P4,P5,P6) with organic acid added to the

chicken ration (P1,P2,P3,P4,P6) and six samples (Z1,Z2,Z3,P6) with zeolite added Of the four (Z1,Z2,Z3,Z4), zeolite and organic acid were added for six samples ((Z+P)1,(Z+P)2,(Z+P)3,(Z+P)4,(Z+P)5,(Z+P)6) of three ((Z+P)1,(Z+P)2,(Z+P)3) of six samples with no addition (control) (K1,K2,K3,K4,K5,K6) on the other hand, it was determined that the two (K1,K5) were higher than the general grey correlation degree average (0.558), which means that there is a ranking from best to worse (Organic) between the groups in terms of quality and performance.

Table 3. Grey relational degrees calculated over real values

	γ_i	Rank	S_{γ_i}	$\gamma_i \pm S_{\gamma_i}$
K1	0.633	3	0.218	0.415±0.851
K2	0.459	23	0.068	0.391±0.527
K3	0.507	21	0.134	0.373±0.641
K4	0.464	22	0.136	0.328±0.600
K5	0.570	10	0.111	0.459±0.681
K6	0.531	18	0.182	0.349±0.714
Z1	0.560	13	0.154	0.407±0.714
Z2	0.561	12	0.180	0.382±0.741
Z3	0.608	6	0.224	0.383±0.832
Z4	0.587	7	0.197	0.390±0.783
Z5	0.517	19	0.142	0.375±0.659
Z6	0.534	17	0.250	0.284±0.784
P1	0.630	4	0.175	0.455±0.805
P2	0.572	9	0.176	0.396±0.748
P3	0.635	2	0.221	0.414±0.857
P4	0.565	11	0.196	0.369±0.761
P5	0.544	15	0.142	0.402±0.686
P6	0.653	1	0.196	0.457±0.849
(Z+P)1	0.615	5	0.230	0.385±0.845
(Z+P)2	0.553	14	0.166	0.387±0.719
(Z+P)3	0.584	8	0.219	0.365±0.803
(Z+P)4	0.515	20	0.166	0.349±0.682
(Z+P)5	0.536	16	0.137	0.399±0.673
(Z+P)6	0.460	24	0.101	0.360±0.561
Mean	0.558		0.172	0.386±0.730

Comparing according to grey relationship degrees, it is stated that the sample with a grey relationship degree value close to 1 is of the best quality. The grey relationship degree ranges from 0 to 1. A grey relationship degree close to 1 indicates that the relationship between the actual values and reference values is high, that is, close to 0, it is low. The reference values were taken as the best quality value (1) for each variable. Accordingly, we can say that the closer the grey relation degree value is to 1, the higher the quality of the egg, and the closer it is to 0, the lower the quality in determining the quality egg using the grey relational analysis method. Accordingly, in Table 6, when egg samples are compared according to the grey relation degrees calculated by considering the real data set, the best quality eggs are P6 (0.653), P3 (0.635), K1 (0.633), P1 (0.630), (Z+P)1 (0.615), Z3 (0.608), Z4(0.587), (Z+P)3 (0.584), P2 (0.572), K5 (0.570), P4 (0.565), Z2 (0.561), Z1 (0.560) , (Z+P)2 (0.553), P5 (0.544), (Z+P)5 (0.536), Z6 (0.534), K6 (0.531), Z5 (0.517) , (Z+P)4 (0.515) , K3 (0.507), K4 (0.464), K2 (0.459) and (Z+P)6 (0.460) were determined respectively. Therefore, considering all the parameters examined, it can be stated that the best egg belongs to the P6 sample, and the lowest value egg belongs to the (Z+P) 6 sample. At the same time, the grey relationship degrees of P6, P3, K1, P1, (Z+P)1, Z3, Z4, (Z+P)3, P2, K5, P4, Z2 and Z1 eggs are higher than the average (0.558) indicates that the eggs are of acceptable quality. However, when comparing the grey relation degree values between each egg sample, the difference between the grey relation degree values is significantly higher, which reveals the difference between the two eggs more clearly. It can be said that the difference between the grey correlation degree values of P6 and P3 egg samples is very low (0.653-0.635=0.018), so P6 is better than P3, but the quality difference between P6 and P3 egg samples is not significant. On the other hand, the high difference (0.653-0.460=0.193) between the grey correlation grade values of P6 and (Z+P) 6 egg samples indicates that the quality grade between P6 and (Z+P) 6 eggs is significant and that P6 (Z+P) 6 indicates better quality.

4. Conclusion

The gray relational analysis method is a suitable method for selecting quality characters, especially for selecting or comparing individual samples with small sample sizes.

Author Contributions

AMY; developed, organized, analyzed and interpreted the data and wrote the manuscript. MT; initiated the research idea, supervised the research, suggested the research methods, structured the paper and edited the manuscript.

Ethical Approval

Ethics committee approval required for this study was obtained from Atatürk University Experimental Animals Local Ethics Committee Presidency (decision no. 10/189, dated 30.12.2015).

Conflict of Interest

The authors declared that there is no conflict of interest.

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Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.912411

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 5 - Issue 1: 21-26 / January 2022

GENETIC DIVERGENCE OF LOWLAND RICE (*ORYZA SATIVA* L.) GENOTYPES IN UGANDA

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Abstract: Forty-eight lowland rice genotypes with two checks were evaluated for agronomic performance, genetic variability, heritability, and genetic advance for yield and yield contributing traits. Genotypes SR33859-HB3324-133 (45.7 qha^{-1}), SR33859-HB3324-93 (40.2 qha^{-1}) were the high yielding genotypes above the better check. The analysis of variance showed significant differences for all measured traits and indicating the presence of high genetic variability among genotypes. A highly significant (P≤0.001) correlations were observed between flag leaf length and plant height (rp= 0.76 and rg=0.84), panicle length and plant height (rp= 0.77, rg= 0.90), and panicle length and flag leaf length (rp= 0.75 and rg= 0.89). The estimates of GCV were lower than the respective PCV for all traits, indicating the influence of environmental factors on the expression of the traits. Characters like grain yield (94 % and 90.9), flag leaf length (97 % and 71.6), number of effective tillers per hill (91 % and 67.2) and plant height (99.0 % and 50.7) showed high heritability coupled with moderate genetic advance as percent of the mean, which suggesting that these traits are controlled by the additive type of gene action and selection could be possible for the improvement of these characters. Moderate heritability estimates with low genetic advance as percent of the mean were recorded for flag leaf width and number of days to maturity indicated the presence of non-additive gene effects, and selection for these traits would be poor. As a result, the variability that exists in the germplasm provides an opportunity to use these genotypes in the genetic improvement program.

Keywords: Rice, Variability, GCV, PCV, Heritability, Genetic advance

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Received: April 09, 2021
Accepted: October 12, 2021
Published: January 01, 2022

Cite as: Zewdu Z. 2022. Genetic divergence of lowland rice (*Oryza sativa* l.) genotypes in Uganda. BSJ Agri, 5(1): 21-26.

1. Introduction

Rice (*Oryza sativa* L.) is most commonly produced in Asia, Africa, and Australia (Dogara and Jumare, 2014). It is the third most cultivated cereal crop in the world, after wheat and maize (FAO, 2018). Rice production in Uganda started in 1942, mainly to feed the World War II soldiers. However, due to a number of constraints, production remained minimal until 1974. Today rice is grown mainly by small-scale farmers almost throughout the country, but also by large-scale farmers in few places (Kijima, 2012). Most of the rice production in Uganda is in the Eastern parts of the country, followed by the Western part of Uganda. According to Dewina et al., (2010) rice accounted for 0.42 % of the total production of food crops in Uganda and ranking fifth after maize, cassava, bananas, and beans.

Paddy rice production in Uganda ranged from 72,000 to 97,505 hectares with a total yield of 109 to 262,631 thousand tonnes respectively from 2000 to 2017 (FAO, 2018). Since the introduction of upland rice in 2002, farmers producing rice in Uganda increased from 4,000 then to over 35,000 in 2012 (Kijima and Sserunkuuma,2006). Even though the production of rice in the country is increasing in terms of the area while the national productivity of the crop doesn't exceed 2.81 tonnes per hectare. According to Akongo, (2017), rice production in the country is constrained by variability in climate, poor market prices, weed infestation, poor seed variety, bird damage, limited knowledge, and declining soil fertility.

Creating genetic variability either by crossing and/or introduction would be one of the solutions to increase the chance of selection and success in the breeding program. Genetic improvement of any crop mainly depends upon the amount of genetic variability present in the population. The success of breeding depends on the extent and the magnitude of variability existing in the germplasm, the heritability of the traits, and information on the genetic variability, and degree of transmission of the target traits. The variability available in the population can be partitioned into heritable and non-heritable component viz., phenotypic and genotypic coefficients of variation, heritability, and genetic advance on which selection can be effectively carried out.

Heritability is the degree of correspondence between the phenotype and the breeding value of an individual for a particular trait which enables the breeders to select the elite variety for a character. However, heritability indicates only the effectiveness with which selection of a genotype can be based on phenotypic performance but it

fails to indicate the expected genetic progress in one cycle of selection. According to Johnson et al., (1955), high heritability alone is not enough to make an efficient selection, unless the information is accompanied by for substantial amount of genetic advance. As a result, the present investigation was undertaken to assess the agronomic performance, the nature, and magnitude of genetic variability, heritability, and genetic advance among the genotypes for further utilization in breeding programs.

2. Material and Methods

A field experiment was conducted at the National Crops Resources Research Institute (NaCRRI) in Kampala, Uganda in the two cropping seasons of 2015 (referred to as seasons 2015 A and 2015 B) with the objective of evaluating the genetic variability of KAFACI materials for yield and yield related traits. NaCRRI is located at 0° 31' N, 32° 35' E, with a mean altitude of 1150 meters above sea level. The soils are ferralitic (red sandy and clay loam) and have a pH range of 4.9 - 5.0. The average annual rainfall is 1300 mm and maximum and minimum temperature of 28.5 ˚C, and 13.0 ˚C, respectively. List of genotypes used for the study are presented in Table 1.

A nursery was raised for each genotype and twenty-one days old seedlings of forty-eight genotypes were transplanted in the swamp field in a 6 by 8 alpha lattice design with two replications. The spacing was 20 cm between rows and between plants and 40cm between plots and between blocks with 1 meter between replications. Each treatment was transplanted in plot size of 1.6 m length and 1 m wide. The fertilizers, Diammonium Phosphate (DAP) (18-46-0) at a rate of 0.96 kg and urea (46-0-0) 1.7 kg/experimental area were used. Half of the Urea and the DAP fertilizer were applied during transplanting. The remaining half urea fertilizer was applied four weeks after transplanting as top dressing to all plots. Weeding and other cultural practices were conducted as needed.

Table1. List of genotypes used for the study

	Designation		Code	Designation	Code		Designation	Code
1	SR33859-HB3324-75	17	G1	SR33701-HB3330-73	G17	33	SR34042-HB3368-196	G33
2	SR33859-HB3324-80	18	G2	SR33701-HB3330-78	G18	34	SR34042-HB3368-228	G34
3	SR33859-HB3324-93	19	G3	SR33701-HB3330-86	G19	35	SR34034F3-125	G35
4	SR33859-HB3324-108	20	G4	SR33701-HB3330-90	G20	36	SR34034F3-135	G36
5	SR33859-HB3324-133	21	G5	SR33701-HB3330-95	G21	37	SR34034F3-147	G37
6	SR33859-HB3324-142	22	G6	SR34461-HB3369-54	G22	38	SR34035F3-57	G38
7	SR33686-HB3326-2	23	G7	SR34461-HB3369-65	G23	39	SR34035F3-182	G39
8	SR33686-HB3326-8	24	G8	SR34461-HB3369-67	G24	40	SR34038F3-13	G40
9	SR33686-HB3326-12	25	G9	SR34461-HB3369-105	G25	41	SR34038F3-32	G41
10	SR33686-HB3326-37	26	G10	SR34461-HB3369-108	G26	42	SR34038F3-42	G42
11	SR33698-HB3329-66	27	G11	SR34461-HB3369-118	G27	43	SR34038F3-75	G43
12	SR33698-HB3329-70	28	G12	SR34462-HB3370-64	G28	44	SR34040F3-29	G44
13	SR33701-HB3330-35	29	G13	SR34461-HB3369-120	G29	45	SR34042F3-3	G45
14	SR33701-HB3330-44	30	G14	SR34461-HB3369-139	G30	46	SR34566-7	G46
15	SR33701-HB3330-56	31	G15	SR34042-HB3368-170	G31	47	NERICA-1	G47
16	SR33701-HB3330-71	32	G16	SR34042-HB3368-182	G32	48	IR-64	G48

Data collection was done according to the standard evaluation system for rice described by (IRRI, 2014). Data were collected on five randomly selected and tagged plants for number of effective tillers per hill, plant height (cm), flag leaf length, flag leaf width, panicle length (cm) while, number of days to heading, number of days to maturity and grain yield (kg ha^{-1}) were recorded on plot basis.

The data collected on above mentioned traits were subjected to alpha lattice restricted maximum likelihood (ReML) analysis in GenStat 12th edition software package (Payne et al., 2009). The genotypes were considered a fixed effect while blocks, replications and season were random effects. Means of significant treatments effects were separated using LSD at P≤0.05 level of significance. Correlation analysis was done to determine the relationship among different traits included in the study.

The linear model for the across season analysis was as follows (equation 1);

$$y_{ijk} = u + s_i + g_j + r/b_{ik} + (s \times g)_{ij} + e_{ijk} \quad (1)$$

Where, y_{ijk} = observed value from each experimental unit, u = mean, s_i= effect of the ith season, g_j= effect of jth genotype, r/b_{ik}= effect of replication nested within the kth block, $(s \times g)_{ij}$ = interaction effect of jth genotype and the ith season and e_{ijk} = the experimental error.

In addition to these, phenotypic, genotypic variance were estimated and genetic parameters like genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and heritability in broad sense and genetic advance as percent of mean were calculated as follows. The variance components obtained from the across season analysis result were calculated as (equation 2);

$$V_{ph} = V_G + V_{gs}/r + V_e/rs \quad (2)$$

Where, r and s are the number of replications and seasons respectively.

The phenotypic (PCV) and genotypic (GCV) coefficients of variation were obtained as the ratio of the respective phenotypic ($\sqrt{V_{ph}}$) and the genotypic ($\sqrt{V_G}$) standard deviations to the trait means. Broad sense heritability (H) was estimated as the percentage of the genotypic to the phenotypic variance (V_G/ V_{ph}). The genetic advance (GA) and genetic advance as percent of the mean (GAM) expected from selection of the best 5 % of the genotypes were calculated as (equation 3);

$$GA = K*(\sqrt{V_{ph}}) * H \text{ and } GAM=GA/x) *100 \quad (3)$$

Where, GA= genetic advance; H= heritability; GAM= genetic advance as percent of the mean; K= selection intensity of 5%=2.06 and $\sqrt{V_{ph}}$ =phenotypic standard deviation.

3. Results and Discussion

3.1. Analysis of Variance

The analysis of variance across seasons revealed highly significant differences (P≤0.001) among genotypes for number of effective tillers per hill, number of days to 50 % heading, number of heading to maturity, panicle length and grain yield while significant at (P≤0.01) for flag leaf length and flag leaf width (Table 2). Genotype-by-season interaction effect was significant (P≤0.001) for number of days to maturity and plant height and significant difference (P≤0.01) for grain yield. There were no significant interactions among genotypes and seasons for effective tiller numbers per hill, number of days to heading, flag leaf length, flag leaf width and panicle length.

Table 2. Combined analysis of variance for grain yield and agronomic traits of 48 lowland rice genotypes evaluated in 2015 A and B cropping seasons at NaCRRI

	df	TL	DH	DM	PH	FLL	FLW	PL	GY
Rep	1	3.33ns	21.33*	8.76ns	299.90***	57.54***	0.021***	4.29ns	25.89ns
Rep/block	14	10.91**	37.81***	5.87ns	74.64***	10.69**	0.044**	2.48ns	54.05***
Genotypes (G)	47	35.26***	153.38***	33.83***	421.06***	54.42**	0.063**	10.70***	176.01***
Year (Y)	1	2.96ns	13.31ns	11.45ns	6.90 ns	19.35**	0.962**	8.07**	175.14***
G*Y	47	4.28ns	2.02ns	21.74***	3.96***	1.01 ns	0.052 ns	0.72ns	16.15**
Residual	81	5.61	4.4	5.57	17.06	4.34	0.011	1.55	8.26
Total	191	12.94	43.06	16.57	118.9	16.67	0.040	3.71	55.80
Mean		17.09	81.30	113.47	82.77	20.90	1.47	18.33	29.18
CV		13.86	2.58	2.08	4.99	9.97	7.14	6.79	9.85
LSD (5%)		4.73	2.96	3.33	5.82	4.16	0.17	2.48	5.74

, * Significant at 1 % and 0.1 % respectively, NS= non- significant, TL= number of effective tillers, DH= number of days to heading, DM=number of days to maturity, PH= plant height, FLL= flag leaf length, FLW= flag leaf width, PL=panicle length, GY= grain yield (quintal ha^{-1})

3.2. Agronomic Performance of Rice Genotypes

The mean values of genotypes evaluated across seasons under field conditions for agronomic traits is presented in Table 3. The lowest number of effective tillers per hill were found on genotypes G47 (11.6) and G24 (12.9), while the highest number of effective tillers was found on G3 (24.4) and G12 (24.1), the overall mean being 17.1 effective tillers per hill. With an overall mean of 81 days until heading, the earliest heading genotypes were G21 (70 days) and G6 and G9 (71 days), and while genotypes G40 (96 days) was late flowering. In measuring number of days to maturity, the overall mean of 113 days, genotypes G16 (106) followed by G47 (107) days were mature early while genotypes G1 ang G36 took long to mature (120) days.

There was a difference among genotypes in plant height with an overall mean of 82.8 cm. Genotypes G27 (106.9 cm) and genotype G48 (105.3 cm) were tallest while genotypes G23 (58.9 cm) and G47 (65.7 cm) were the shortest. Genotypes showed long flag leaf were G37 (29.2 cm) and G27 (28.6 cm) and shortest flag leaf was recorded on G47 (15.1 cm) with mean of 20.9 cm. On the other hand, G2 and G21 gave the shortest flag leaf width (1 cm) while G29 was 1.6 cm.

The average panicle length was 18.3cm, with the longest panicles recorded on genotypes G27 (22.4 cm) and G1 and G37 (21.6cm). Genotypes G9 and G23 (17.5 cm) and G28 (16.0 cm) had short panicles. An overall mean of 29.2 qha^{-1} for yield with variation among genotypes, the highest yield was recorded on genotypes, G5 (45.7 qha^{-1}), G3 (40.2 qha^{-1}), G44 (39.1 qha^{-1}). The genotypes with the lowest yield included G3 (17.8 qha^{-1}), followed by G33 (18.8 qha^{-1}).

Genotypic and Phenotypic associations among measured traits

Phenotypic and genotypic correlation of across-season evaluation of the introduced rice genotypes for grain yield and other agronomic traits in field conditions is presented in Table 4. The results showed a moderate positive significant (P≤0.001) correlation between

number of effective tillers per hill and grain yield (rp=0.47 and rg= 0.58), number of days to maturity and flag leaf length (rp= 0.49, rg=0.0.73), flag leaf length and number of days to heading (rp and rg= 0.43) and flag leaf width and number of days to heading (rp=0.49, rg=0.97). A highly significant (P≤0.001) correlations were observed between flag leaf length and plant height (rp= 0.76, rg=0.84), panicle length and plant height (rp= 0.77, rg= 0.90), and panicle length and flag leaf length (rp= 0.75, rg=0.89). Suwansa et al. (2017), Seyoum et al. (2012) and Sravan et al. (2012) had also reported that flag leaf length, number of panicles per plant and number of spikelets per panicle had significant positive phenotypic coefficients affecting grain yield per plant. On the other hand, a low non-significant negative correlation was observed between number of days to heading and grain yield (rp= -0.13, rg= -0.07). Suwansa et al. (2017), also reported similar findings that days to flowering had a significant negative phenotypic correlation with grain yield.

Table 3. The mean performance of the genotypes across two seasons

Code	TL	DH	DM	PH	FLL	FLW	PL	PB	GY
G1	17.7	86	120	99.3	28.4	1.5	21.6	17.1	23.2
G2	15.4	72	113	68.2	17.6	1.0	18.1	20.8	25.5
G3	24.4	80	113	84.9	18.3	1.1	16.8	15.3	40.2
G4	17.7	73	111	76.5	17.0	1.1	18.9	28.7	33.2
G5	15.8	78	112	80.1	19.4	1.3	19.2	13.8	45.7
G6	14.4	71	108	79.3	18.2	1.1	17.2	18.7	33.4
G7	18.1	77	112	80.1	21.1	1.1	17.7	9.2	34.0
G8	15.1	75	112	79.0	16.6	1.2	17.1	24.8	23.6
G9	20.5	71	111	72.5	16.6	1.1	15.7	12.1	33.0
G10	18.0	80	114	80.3	22.1	1.2	19.6	21.9	34.6
G11	18.0	77	118	79.7	19.7	1.3	18.1	18.1	37.2
G12	24.1	84	114	85.6	24.2	1.2	19.6	11.2	35.8
G13	19.5	83	113	91.8	22.3	1.3	19.6	19.1	36.1
G14	15.5	75	110	76.4	17.1	1.2	17.1	17.9	32.0
G15	15.0	81	113	72.4	18.5	1.2	17.4	16.7	31.2
G16	15.2	77	106	75.2	18.9	1.2	17.3	24.5	25.3
G17	14.8	76	111	92.2	21.2	1.2	19.3	19.5	27.9
G18	19.3	74	116	95.5	25.1	1.4	19.6	13.7	35.2
G19	15.6	78	111	81.5	19.9	1.2	17.3	22.1	21.7
G20	15.7	75	110	83.6	17.9	1.1	17.2	30.1	21.1
G21	17.7	70	113	76.8	18.5	1.0	18.5	25.2	36.9
G22	17.6	79	112	71.2	20.3	1.2	16.7	18.3	26.1
G23	17.5	77	116	58.9	15.3	1.1	15.7	23.0	24.4
G24	12.9	89	115	77.6	20.0	1.5	18.2	13.0	32.7
G25	17.2	83	112	77.9	19.6	1.2	16.9	14.5	27.3
G26	18.9	81	114	93.2	26.5	1.3	21.0	11.5	29.8
G27	20.7	86	113	106.9	28.6	1.4	22.4	12.6	35.9
G28	16.9	87	111	76.2	18.4	1.3	16.0	24.0	37.5
G29	20.9	84	112	90.8	23.9	1.6	19.6	13.2	31.8
G30	13.5	80	117	76.5	21.5	1.4	18.5	21.5	19.6
G31	13.2	82	115	99.8	21.8	1.3	20.7	14.7	29.5
G32	15.8	89	117	87.6	20.2	1.1	18.2	37.3	17.8
G33	14.1	81	113	78.8	16.7	1.2	16.4	36.7	18.8
G34	14.1	83	113	79.9	17.3	1.2	17.9	34.0	19.8
G35	14.2	84	112	79.3	18.2	1.2	17.3	42.9	22.7
G36	17.8	79	120	92.3	27.2	1.3	18.8	28.6	24.8
G37	17.0	82	111	102.8	29.2	1.2	21.6	21.0	24.3
G38	21.5	90	117	89.0	25.9	1.3	20.5	16.8	30.9
G39	19.9	92	117	78.3	20.5	1.3	20.2	18.8	34.5
G40	19.4	96	116	88.5	24.8	1.2	19.7	18.6	21.1
G41	13.7	88	116	74.6	19.5	1.1	16.3	18.5	21.0
G42	23.5	93	115	76.8	22.8	1.4	16.5	19.8	36.6
G43	21.6	90	115	78.0	22.2	1.2	19.2	22.6	28.3
G44	15.8	81	115	101.3	22.9	1.5	19.7	33.1	39.1
G45	15.7	88	112	74.1	15.5	1.3	17.3	28.5	20.9
G46	14.7	89	113	77.9	26.9	1.3	17.1	28.5	21.7
G47	11.6	74	107	65.7	15.1	1.1	16.4	61.0	20.1
G48	13.5	88	117	105.3	24.2	1.4	18.9	18.9	34.4

TL= number of effective tillers, DH= number of days to heading, DM=number of days to maturity, PH= plant height, FLL= flag leaf length, FLW= flag leaf width, PL=panicle length, PB= panicle blast and GY= grain yield (quintal ha^{-1})

Table 4. Estimate of phenotypic and genotypic correlations of 48 rice genotypes evaluated at NaCRRI, Uganda in 2015 A and B cropping seasons

		TL	DH	DM	PH	FLL	FLW	PL
DH	rp	0.212						
	rg	0.206						
DM	rp	0.24	0.491***					
	rg	0.311	0.818***					
PH	rp	0.168	0.253	0.356***				
	rg	0.233	0.255	0.385**				
FLL	rp	0.357**	0.434***	0.494***	0.763***			
	rg	0.374	0.432***	0.736***	0.841***			
FLW	rp	0.08	0.496***	0.427**	0.519***	0.563***		
	rg	0.189*	0.978***	0.970***	0.811***	0.947***		
PL	rp	0.259	0.248	0.406**	0.778***	0.758***	0.433**	
	rg	0.287	0.256	0.492***	0.909***	0.895***	0.789***	
GY	rp	0.473***	-0.132	0.016	0.203	0.116	0.213	0.223
	rg	0.589***	-0.074	0.018	0.268*	0.173	0.6171***	0.292

rp= phenotypic correlation coefficient and rg=genotypic correlation coefficient

Phenotypic and genotypic variances, expected genetic advance and heritability for grain yield and yield contributing traits of rice genotypes

The phenotypic coefficients of variation, genotypic coefficients of variations, variances, heritability in broad sense, genetic advance at 5 % selection intensity and genetic advance as percent of the mean for all measured traits are presented in Table 5. The estimates of PCV and GCV indicated the existence of variability of genotypes included in the study. In general, the phenotypic coefficients of variations were higher than the genotypic coefficients of variations for all measured traits. The largest phenotypic variation was observed for grain yield (46.25 %) followed by number of effective tillers per hill (35.9 %), flag leaf length (35.7 %) and plant height (24.9 %). In line with this, the maximum genetic coefficient of variation was also recorded for grain yield (44.9 %) followed by flag leaf length (35.2 %) and number of effective tillers per hill (34.2 %).

Table 5. Phenotypic and genotypic variances, heritability and expected genetic advance of 48 lowland rice genotypes evaluated at NaCRRI over two cropping years

Measured traits	Genetic parameters						
	GV (σ^{2g})	PV (σ^{2p})	GCV (%)	PCV (%)	H^2 (%)	GA (%)	GAM (%)
TL	34.19	37.73	34.22	35.95	0.91	11.48	67.19
DH	152.88	154.99	15.21	15.31	0.99	25.33	31.16
DM	28.40	40.66	4.70	5.62	0.70	9.19	8.10
PH	420.07	426.32	24.76	24.94	0.99	41.97	50.71
FLL	54.17	55.76	35.22	35.74	0.97	14.97	71.62
FLW	0.05	0.08	15.22	19.10	0.63	0.37	25.02
PL	10.52	11.27	17.70	18.31	0.93	6.47	35.28
GY	171.98	182.12	44.94	46.25	0.94	26.29	90.09

GCV= genetic coefficient of variation, PCV= phenotypic coefficient of variation, H2= heritability in broad sense, GA=genetic advance at 5 % selection intensity, GAM=genetic advance as percent of the mean

Senapati and Kumar (2015), Suwansa et al. (2017), Biswaranjan et al. (2018), Nikki and Parmar (2020) had also reported high phenotypic and genetic coefficients of variation for grain yield per plant, number of panicles per plant, and number of spikelets per panicle. On the other hand, the smallest phenotypic (5.6 %) and genotypic coefficients of variations (4.7 %) were recorded on number of days to maturity and number of days to heading 15.3 % and 15.2 % respectively.

Estimation of the extent of heritability enables breeders to know the extent of which improvement is possible through selection. According to Burton (1952) genetic advance in combination with heritability gives a more reliable index for selection of traits than heritability alone. High degree of heritability was recorded for all measured traits in this study. It ranged from 63.0 % for flag leaf width to 99.0 % for number of days to heading. High heritability estimates associated with moderate to high genetic gain were observed for grain yield, plant height and flag leaf width. This indicated that the

influence of environments on the expression of this traits were low. Low genetic advance as percent of the mean coupled with low estimates of heritability were recorded for number of days to maturity, flag leaf width and number of days to heading, which indicated higher influence of environments on and hence, population improvement approach would be most effective for improvement of these characters that selection at early generation. As indicated in Table 5, the presence of sufficient variability in the studied traits showed high possibility to explore the material for further genetic improvement program.

Conclusion

The materials used in the study showed a highly significant difference for all measured traits and indicating the presence of substantial genetic variations and thus provide enough scope for selection. Among the tested genotypes SR33859-HB3324-133 (45.7 qha^{-1}), SR33859-HB3324-93 (40.2 qha^{-1}) were the high yielding genotypes above the check and could be further evaluated in different locations and seasons before assuring for production. Moderate to a high degree of heritability estimates and high, GCV and PCV were found for grain yield, number of effective tillers per hill and flag leaf length which indicating the low or negligible influence of environment in the expression of this traits. The presence of sufficient variability in the studied traits, gives possibilities to explore the material for further genetic improvement program and also to widen the genetic background of various rice genotypes.

Author Contributions

All task made by single author and the author reviewed and approved the manuscript.

Conflict of Interest

The author declared that there is no conflict of interest.

Acknowledgments

I would like to thank Alliance for Green Revolution in Africa (AGRA) for the financial support and Ethiopian Institute of Agricultural Research for giving study leave. Fogera National Rice Research and Training Center (FNRRTC) had also acknowledged for hosting the author for his internship. The author had also grateful for the National Crop Research Resources Institute (NaCRRI) of Uganda, especially rice research programme for hosting the research activity.

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Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.984780

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 5 - Issue 1: 27-39 / January 2022

AGRICULTURE AND RURAL DEVELOPMENT PLANS IN IRAN: SITUATIONS AND PROBLEMS

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Abstract: Most poor people presently reside in rural areas. The rural poor are exposed to many risks while often lacking instruments to manage them adequately, and so are highly vulnerable. Nowadays sustainable rural development is a pillar and focal point in most discussions for betterment of conditions especially in developing countries such as Iran. After Islamic revolution of 1978, rural development has been gotten very more attention in comparison to previous government namely Shah. But because of many causes such as eight years' war between Iran and Iraq during 1980-1988 and international sanctions against Iran in four previous decades, and also absence of a holistic and systematic view in rural development programs in Iran, many of these plans didn't acquire pre-determined goals and objectives in comparing to budget that consumed for them and immigration rate from rural to urban regions didn't decrease. In this article, state a brief and comprehensive discussion about plans, challenges and opportunities of rural development projects in Iran with emphasizing on effectiveness of these experiences and affairs in one of the most disadvantaged regions in Iran namely South-Khorasan province in desert region in east of Iran plus Isfahan province in center of Iran. Results of this study indicate relative successful of these rural development programs in maintaining people in their villages and providing jobs and other facilities for continuing their livings despite near three decades strong drought in these disadvantaged regions. Even though in future policy makers and program planers must consider more holistic, systematic and scientific patterns in their affairs in these domains.

Keywords: Development, Agriculture, Rural, Sustainable, Opportunities, Iran

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Received: August 19, 2021
Accepted: October 14, 2021
Published: January 01, 2022

Cite as: Golmohammadi F. 2022. Agriculture and rural development plans in Iran: situations and problems. BSJ Agri, 5(1): 27-39.

1. Introduction

Most poor people presently reside in rural areas. The rural poor are exposed to many risks while often lacking instruments to manage them adequately, and so are highly vulnerable (Anderson, 2003). The term ''development'' has been used in many ways, and there are numerous interpretations of the concept. Among various definitions is the common idea that economic growth is indicative of development (Park and Stokowski, 2009).

Rural development is the process of improving the quality of life and economic well-being of people living in relatively isolated and sparsely populated areas. Rural development has traditionally centered on the exploitation of land-intensive natural resources such as agriculture and forestry. However, changes in global production networks and increased urbanization have changed the character of rural areas (Živkovic et al., 2009).

It is not an exaggeration to say that the battle to achieve the global society's stated objectives on hunger and poverty reduction will be won or lost in the rural areas of the developing countries. Globally, extreme poverty continues to be a rural phenomenon despite increasing urbanization. Of the world's 1.2 billion extremely poor people, 75 percent live in rural areas and for the most part they depend on agriculture, forestry, fisheries and related activities for survival. The promotion of the rural economy in a sustainable way has the potential of increasing employment opportunities in rural areas, reducing regional income disparities, stemming pre-mature rural-urban migration, and ultimately reducing poverty at its very source. In addition, development of rural areas may contribute to the preservation of the rural landscape, the protection of indigenous cultures and traditions while rural societies could serve as a social buffer for the urban poor in periods of economic crisis or social urban unrest. However, public policies at national level and resource mobilization at both national and international levels have not always recognized the multiple potential of the rural economy. Public policies and investments in developing countries have historically favored industrial, urban and service sectors at the expense of agricultural and other rural sector development. In many cases, a coherent rural development policy (by its very nature crosscutting) has fallen victim of the lack of a cross-sectored institutional framework (Anríquez and Stamoulis, 2007).

Among the diverse occupants of rural space, farmers and

the rural labor force stand out as the groups most different from their urban cousins, and accordingly are given particular attention here. Needless to say, the close connections between farmers and other business operators in rural areas means that many of the observations made about farmers will have validity for both groups (Anderson, 2003).

The definition of rural development has evolved through time as a result of changes in the perceived mechanisms and / or goals of development. A reasonable definition of rural development would be: development that benefits rural populations; where development is understood as the sustained improvement of the population's standards of living or welfare. This definition of rural development, however, has to be further qualified (Anríquez et al., 2007).

Over the past few decades, many agricultural development projects (ADPs) have been initiated in Iran to alleviate poverty, unemployment, and an insufficient food supply. Although these projects were assumed to be beneficial for rural people, they often had unintended negative impacts on the environment and local communities. The projects were largely unregulated and the impacts often unmitigated. As a result, Iran has suffered from social and environmental degradation in many agricultural areas. Recently, however, ADPs in Iran and elsewhere have been criticized for their detrimental social and environmental impacts at the local level and to the world ecology at large (Ahmadvand et al., 2009).

Iran is one of the largest nations in the Middle East with a land area of around 1.65 million square kilometers and a population in excess of 84 million. About 18.5 million ha extent of Iran are cultivated lands. In Iran, like other developing countries, agriculture is one of the most important economic sectors and comprises a considerably high percentage of production and employment. In Iran 20 million people living in 62000 villages who directly or indirectly depend on agriculture to survive, while most of them are living under poverty line. Still Iranian rural economy is dominated by agricultural sector which accounts for 8% of GDP, 17.7% of employment opportunities, 85% of food supply and 15% of non-oil exports, plus considerable raw materials for industrial use. Total amount of agricultural productions in Iran is 124 million tons that 83.5 million tons of it contains crop production (Iranian Bureau of Statistics, 2021).

These figures show that rural economy has an important role in national economy. To establish a sustainable economy in rural areas, almost every village needs credit, clean seeds, infrastructure and guidance in crops and livestock production. They also need farm machinery, marketing facilities, cooperatives, water supplies, education and diverse economic activities. For a sustainable and efficient rural development, each village must be provision with all of these inputs and functions. Integration of the functions and efficient management demand an active and sustainable local communities and institutions in Iran. Nowadays, rural sustainability is one of the main issues of sustainable development programs in developing countries such as Iran. Of course not only it is useful to know rural sustainability criteria, but it is also more important to evaluate and prioritize them (Nooripoor and Shahvali, 2011).

In this article, state a brief and comprehensive discussion about plans, challenges and opportunities of rural development projects in Iran with emphasizing on effectiveness of these experiences and affairs in one of the most disadvantaged regions in Iran namely South-Khorasan province in desert region in east of Iran plus Isfahan province in center of Iran.

2. Materials and Methods

Main locations of doing this study were two provinces of Iran, namely South Khorasan province, east of Iran (especially, first rank of doing this study) and Isfahan province, in the center of the country (second rank of doing this study), because of accessibility of them for researcher. Statistical society of the research includes rural people in some selected rural regions in these provinces. For doing this study utilized qualitative approach with its main tools for gathering information such as participatory observation, maps, scientific articles, pictures, documents (Iranian and foreign scientific magazines and journals, TV and radio programs, Iranian Bureau of Statistics), discussion with experts, professors and beneficiaries and field research specially in above two provinces. In below map, shows locations of doing this study as A and B (Figure 1).

Figure 1. Map locations of doing this study, A (South Khorasan Province, east of Iran) and B (Isfahan province, center of the country) (Iranian Bureau of Statistics, 2021).

As Creswell (1994) noted in a qualitative study, one does not begin with a theory to test or verify. Instead consistent with the inductive model of thinking, a theory may emerge during the data collection and analysis

phase of the research or be used relatively late in the research process as a basis for comparison with other theories.

3. Government Organizations in Agricultural and Rural Development in Iran

Today a large number of government organizations deal with the development of agricultural and other issues in rural areas. The institution which is most influential in rural development is the Ministry of Jihad Agricultural, which is responsible for the agricultural sector, forestry, natural resource, fishery and several rural industries in Iran.

Other ministries are involved with the process of rural development according to their area of activities. This implies the sectored approach in rural development prevails over the territorial approach in Iran. The rural problems are tackled by various government institutions and this requires appropriate coordination among them. Lack of such co-ordination and cooperation among institutions and organizations involved in rural development is a serious problem affecting sustainable rural development in Iran. Thus, the main goal of millennium development in Iran should be focus on methods of sustainable rural development. This depends on addressing the challenges of sustainable rural development in Iran.

Rural population in Iran live in an unstable environment and geographically, villages are extremely diverse and more than 65% of them have population less than 250 persons, which do not provide sufficient population threshold for most of services and sustainable economic and job creation activities. Only 7.5% of rural areas have population more than 1000 persons (Kalantari et al., 2008) (Figure 2).

Figure 2. Traditional houses and selling wood by rural people (Pictures by author, January 2021).

4. Immigration Rural Communities to Large Urban Areas in Iran

The shift in population from rural communities to large urban areas has been responsible for social - economic changes in Iran. The attraction to urban areas is mostly due to lack of civil services such as educational and health care services as well as adequate job market in the rural areas. Culturally, the issue of urbanization of rural areas has always been looked upon in a negative way because people tend to think that it interferes, implicitly, with the peaceful environment in villages and rural areas would turn into large congested industrial cities. In addition, there are inherent reasons within the social–economic infrastructure that promotes slower growth in the rural areas (Ardehali, 2006).

Migration from and to depopulating areas is related to the prospects for rural economic regeneration. The focus is on whether or not migration processes give rise to the necessary human capital required for successful endogenous development. Only by leaving rural areas can young adults acquire the necessary skills to participate in endogenous development, however, few out-migrants subsequently return. In-migrants, while often possessing the necessary human capital to bring about an economic regeneration, are associated with relatively little new job creation. Instead immigration is characterized by self-employment. It is argued that migration is a pre-requisite for rural economic regeneration, but that a rural endogenous development policy on its own will have limited success in regenerating areas experiencing on-going depopulation. Exogenous development strategies are also required (Stockdale, 2006).

Traditionally, labor migration and remittance strategies have been used as a social security mechanism by smallholder households in the absence of insurance markets to cover production risk, and such migration continues to be important in many places (e.g. to cope with drought in eastern India). However, recently, young urban migrants from rural regions tend to neglect their traditional obligations to support their elderly parents, especially if they do not intend to return to their native village, do not expect any sizable inheritance, and have no reciprocal insurance commitment with their parents. These various imperfect mechanisms mean that there may be a case for assisting stressed rural households directly (Anderson, 2003).

The migration processes affecting rural areas are important at a time when endogenous development is advocated. This 'bottom-up' approach requires the presence of local human capital and migration processes will either remove or introduce human capital. Prior research into repopulating rural areas suggests that in-migration brings economic benefits and that quality of life considerations is influential in attracting those with job creation potential. Within the context of rural endogenous development migration is a pre-requisite. It

is only by leaving the rural community (out-migration) that young adults are most likely to acquire the necessary skills and knowledge to participate fully in endogenous development (Stockdale, 2006).

Increasingly both academic and government agendas are focusing on the changing structure of national populations. In Iran we observe a rapid decreasing of rural population from 95 percent in 1912 to less than 25 percent in 2021. This lack of Iranian Governments in past century attention to rural demography is particularly significant at a time when rural development policies advocates in their programs. A central aspect of endogenous development is the need for appropriate human capital to be present. Continued outmigration and depopulation, however, are not compatible with endogenous development (Iranian Bureau of Statistics, 2021). Such depopulation is primarily driven by the out-migration of young, often the brightest adults. Much is already known about their decision-making. It is generally acknowledged that the act of migration is beneficial to the individual out-migrant.

Within a given geographical area a variety of migration processes (in, out and return migration) will be evident, irrespective of the overall net migration or population change. With declining natural change variation in population growth rates is increasingly the product of in and out-migration processes. Rural depopulation has been endemic since the beginning of land reformation programs in period of Shah before Islamic revolution 1978 in Iran and recent research confirms its continuation in many parts of Iran despite many investments in past four decades for rural development from Governments in Iran. Many researches indicate that because of absence a holistic and systematic pattern and viewpoint from major policy makers and planners from these Governments in rural development planning, this phenomenon has been caused. The emerging focus on the development consequences of migration for rural communities is particularly timely given that rural economies have undergone a transition from agricultural production to the emergence of consumptive (residence, recreation and environmental conservation) roles (Golmohammadi, 2012).

5. Credit Arrangements in Rural Areas of Iran

Informal credit arrangements are widely used in developing countries, since formal lending institutions often do not consider small farmers as credit-worthy. Rural households often attempt to smooth consumption through reciprocal gifts and informal credit. Formal lending institutions in rural areas may be unwilling to lend money to small farmers as the latter may offer collateral in unacceptable forms (e.g. a small plot of land, livestock, etc.). However, informal moneylenders - the landlord, the shopkeeper and the trader - are in a position to accept collateral in exotic forms. In addition, informal moneylenders often have much better information regarding the activities and characteristics of their clientele. Notwithstanding the existence of such informal mechanisms in rural credit markets, rural residents may be considerably assisted in their risk management by interventions that lead to better access to financial instruments by the rural poor (Anderson, 2003).

The great hope in the financial sector servicing the poor in rural areas today is microfinance (MF), which uses much higher interest rates than the subsidized programs, because such instruments must cover the higher costs of collection and risk of default. All types of institutions are used to reach borrowers, including commercial banks, specialized credit institutions, NGOs, grassroots saving groups, cooperatives and credit unions. When the approach is profitable, the private sector becomes involved, and can also then address the demand for non-credit financial services by the poor. The same sanguine fate is, however, still disturbingly distant for the many rural areas where this is not happening. Plagued by poverty, in all the different senses of assets and incomes, residents of these areas will continue to need the types of social protection supports, such as economy-wide safety nets. The challenge will be an on-going one to rural and other development workers (World Bank, 2020).

Similarly, microfinance services are contributing importantly to helping poor people. More generally, having a financial system serving rural areas in a flexible manner that recognizes the riskiness of life in such space is the best single approach to helping all concerned poor people. As rural space is better served by infrastructure, and economic integration within it increases, the absent-market arguments for intervention will diminish. For the present, however, there are many persistent problems faced by the poor for which policies, institutions and market mechanisms deserve continuing close attention by those concerned with developing rural areas, and with reducing poverty and improving risk management in them.

6. Urbanization and Land-use Changes in Iran

Iran as a dry country with limited water and soil resources is also facing several problems for protecting fertile lands and agricultural. It is estimated that urban growth is responsible for degradation of 10 km2 of farmlands per day in Asian cities. As a worldwide concern, the conflict between urbanization and agricultural land protection is a challenging issue for planners to manage. Such concerns about notorious environmental consequences are caused not only by the area, but also by the spatial arrangement of urbanization process. In other words, policies that only concentrate on the reduction of the area of urban growth may result in undesirable outcomes on welfare and equity of residents, and in contrast, excessive urbanization processes are also

responsible for many environmental impacts as well. Conversion of natural and semi-natural ecosystems into impervious surfaces is associated with many other biophysical processes such as salinization, soil compaction, organic matter decline, soil sealing and soil biodiversity decline, which collectively lead to loss of many valuable soil functions and their corresponding services for crop production (Moein et al., 2018; Golmohammadi, 2012; Golmohammadi, 2020).

Urban growth processes in Iranian environments are mainly initiated from rural centers, which are largely surrounded by farmlands and fertile soils. Such proximity between these two utilities can cause conflict between multiple stockholders of different interests, which is normally associated with removal of agricultural fields and productive lands to provide space for more urban construction. In this regard, during the last four decades, the country has experienced 40% of growth in its population size and urbanism rate, which are also projected to continue during the upcoming decades. Urban expansion on agricultural land-use intensity is associated with a reduction in agricultural land-use intensity and GDP in industrial sector negatively affects farmland intensity. By establishing appropriate socio-economic and cultural-recreational attractions in areas with lower levels of competition, the pressure of future population growth can be shifted to areas with higher suitability for urbanization and lower competitions with farmlands (Iranian Bureau of Statistics, 2021; Moein et al., 2018; Golmohammadi, 2012; Golmohammadi, 2020) (Figure 3).

Figure 3. a) In Razg village (12 km distance to Birjand, center of South Khorasan province, east of Iran) (Pictures by author, Summer 2020). b) In Hariwand, Fanood, Kahi and Khorashad villages (25 - 70 km distance to Birjand, center of South Khorasan province, east of Iran) (By author, January 2021).

7. Land Fragmentation as a Major Barrier in Rural Areas of Iran

Land-use efficiency differs according to land use needs, for example, whether the land is used by large agricultural enterprises: associations, cooperatives, research and education establishments or used by smaller or larger private households. Increasing land-use efficiency is a topical issue in many countries; therefore, indicators of land efficiency measurement systems and ways of calculating economic land efficiency are being developed (Cintina and Pukite, 2018; Golmohammadi, 2021).

Low productivity of small-holder farmers, their limited access to land, combined with water shortage, excessive ground water withdrawal, inadequacy of irrigation systems and excessive post-harvest losses, aging farmers with low literacy, who have limited access to quality seeds of improved variety, are main problems in agriculture system in Iran. For them, low productivity interacts with food security conditions (CPF, 2016).

It is true that in traditional systems, fragmentation had some advantages, but under an agricultural renovation condition, fragmentation is a serious limiting factor. It causes a high increase in costs and makes productivity improvement activities uneconomical. Therefore, consolidation of fragmented plots of lands for achieving optimum size and shape of farmland, directly affects productivity. The experiences of different countries confirm this claim. In view of these considerations, numerous land consolidation and land reform policies have been implemented to reduce fragmentation in European countries like the Netherlands and France, in African countries like Kenya, Tanzania and Rwanda, and elsewhere. Small landholdings were well-adapted to Iran's agriculture sector. With increasing population pressure and more efficient technology, they are coming under increasing strain. In the long run, they may be not adaptive at all. Therefore, for economic crop production, it is necessary to execute land consolidation programs that can provide appropriate living standards for farmers. According to some studies, the optimum farm size for economic crop production should be at least 12 ha. Summarizing these arguments, land fragmentation is considered as one of the major obstacles to achieve sustainable rural livelihoods, in Iran. Accordingly, the extensive arrays of smallholdings need to be restructured and consolidated. A better understanding of the causes of land fragmentation in Iran is needed, especially now that the country is confronted with the challenge of agricultural modernization resulting from its entry into the World Trade Organization (WTO) etc. (Lahsaeizadeh, 2007; Kalantari and Abdollahzadeh, 2008; Golmohammadi, 2021) (Figure 4).

Figure 4. Land fragmentation, peasantry and small holdings as major type of agricultural production system in Razg, Kaseh Sang and Amir Abad Sheybani villages, (7-12 km distance to Birjand city, center of South Khorasan Province, east of Iran) (Pictures by author, January 2021).

8. Inequality in Regional Development of Iran

Regional planning in Iran during the first decade following the Revolution (the 1980s) was based on reducing the development gap between different regions and creating a relative balance in regional development, special attention to the backward areas, control of urban and rural system, control of irregular expansion of the cities and control of physical enlargement of the urban areas, preparing the foundation for hierarchical distribution of services and infrastructure in the entire territory. In the second decade after the Revolution (beginning in 1999), a new direction appeared in the regional planning. The main differences include:

A. Change of the direction of regional planning from national and interregional levels to intra-regional, regional and sub-regional levels.
B. Increased attention to organizing plans for rural areas.
C. Attention to identifying potential and capacities of regions for development (Afrakhteh, 2006).

Conceptually, two approaches have been manifested in Iranian regional planning. One holds regional planning to be a kind of continuation of architecture and the other believes regional planning to be a policy for economic development or an expansion of social justice. Following these two approaches, the regional planning process has been in practice unable to identify the real needs and priorities at different regional levels and consequently their application in responding the needs of the region have been hampered.

On the other hand, the weakness of traditional methods of planning and the ambiguous legal position, responsibility and manner of providing regional plans, and lack of a clear task division among the relevant departments have, in practice, resulted in inter-departmental rivalries and caused parallel movements in compiling regional plans and programs which in the end has hampered their success (Afrakhteh, 2006).

In Iran we saw inequality in regional development. In justifying this regional inequality, some pinpoint the lack of natural resources in various areas. This is mainly claimed by the studies carried out by foreign consulting companies, including Ital Consult. Such studies do not account for the reality that regional inequality was not so marked earlier in the century and why Tehran-which is not comparable in terms of natural resources with, say Khuzestan-has enjoyed a much higher development rate. It is clear that natural resources are an important factor; however, in the absence of a clear and specific policy, they cannot account entirely for a region's development status. Some other commentators attribute the regional inequalities in Iran to ethnic and cultural differences and identify a significant relationship between those and the development of the nation's regions. In response to this, it can be said that while ethnic and cultural differences are not a new issue, regional inequality in its contemporary acute form is a new phenomenon. Yet another approach holds that the country's regional inequalities are related to the limitations of regional markets and the market-oriented nature of Iranian industries. It is clear, though, that such an analysis is addressing the effects rather than the causes of the problem. The Iranian leftists have emphasized international relations, unequal relations between the regions and legacies of imperialism as the significant factors causing regional inequality (Figure 5, Figure 6 and Figure 7).

Figure 5. Carpet weaving in rural house as a main instrument for helping household economy in a disadvantaged rural region (Zirg village, 50 km distance to Birjand, center of South Khorasan province, east of Iran) (By author, October 7, 2012).

Figure 6. Baking bread in a disadvantaged rural region (Zirg village, 50 km distance to Birjand, center of South Khorasan province, east of Iran) (October 7, 2012).

Figure 7. Nomadic lifestyle people and their traditional woman carpet weaver and children with poor health and education conditions in a disadvantaged and dried region near Qaen, 110 km distance to Birjand, center of South Khorasan province, east of Iran (By author, May 27, 2012).

9. Drought and Its Effects on Rural Development in Iran

Information pertaining to a decrease or increase in the amount of rainfall have significant effects on agricultural and municipal water management, especially in arid and semi-arid countries like Iran. Since rainfall is the most important source of water for all agricultural requirements, information about rainfall trends is valuable to policy makers (Ghahraman and Taghvaeian, 2008).

According to latest report that published by National Drought Warning and Monitoring Center (NDWMC) in the year 2020 – 2021 the average amount of rainfall in country determined 127.1 mm that it means it is very lower (about 50 percent) from the long run average precipitation of the country that is 215 mm per year (National Drought Warning and Monitoring Center, 2021).

Arid and semi-arid zones are very sensitive and vulnerable to the climate change impacts. Vulnerability to climate change and other hazards constitutes a critical set of interactions between society and environment. The central Asia is particularly vulnerable due to physical geography, which dominated by temperate deserts and semi deserts. Aridity is expected to increase across the entire Central Asian region. Temperature increases are projected to be particularly high in summer and fall, accompanied by decreases in precipitation.

I.R of Iran is located in the North Temperate Zone which lies between the latitudes of 25° 14’ and 39°42' N and the longitudes of 44° 10' and 63° 11' E with a total area of approximately 1650000 square kilometers. Elevations range from 26 meters below sea level on the shores of the Caspian Sea to 5671 meters above sea level at the pick of the Mt. Damavand. Drought is one of the most critical factors in Iran. About 50 % of Iran can be classified as arid or semi-arid zones. There is not a good annual rainfall distribution in most regions of Iran. Not only high temperature in southern, central and lowlands of Iran is a limiting factor, but also low temperature in northern, western and highlands is another limiting factor too. In the South Khorasan province, a greater portion of land during last decade became warmer than before. This confirmed the overall global warming in the world. The results derived from the trends of climate index confirmed this fact that the overall climate of the province became worse because more than 76% of the lands showed that the region goes to the drier condition (Masoudi et al., 2018).

Iran long-term average annual rainfall is in the range of 224–275 mm/year, making Iran one of the most arid regions of the world. By way of comparison, annual precipitation in Iran is less than one third of the world average (ca 990 mm). The lack of water is a major limitation for agricultural development. The pressure on water resources is increasing as demands for water consumption expand. Increases in population, socially demanded rises in living standards, and the expansion of irrigated agriculture have drastically increased water use to the extent that the sustainability of the water resources of Iran is being threatened. Agriculture typically utilizes around 90 % of Iran’s total water consumption, of which around half is from surface resources and half from groundwater reserves. Drought is directly affecting more than 2.6 million hectares of irrigated farms and 4 million hectares of rain-fed agriculture. A national assessment of water utilization identified that the rate of extraction from aquifers was more than what was permitted in 223 plains (Keshavarz et al., 2013).

Iranian rural and nomadic communities living in drought-prone marginal areas with subsistence economy seem to be most vulnerable during the occurrence of drought crisis. A severe drought which has been unparalleled during the last 30 years, seriously affected most provinces, mostly in southeastern and central Iran. This drought has continued since then in the provinces of Sistan and Baluchistan, South Khorasan and Kerman, affecting all aspects of socio- economic life and has seriously caused damages to environment and natural resources (Golmohammadi, 2012; Hosseini et al., 2009).

Production of rain-fed wheat and barley has been significantly reduced, by 35–75%. Agricultural losses in irrigated areas have also been severe, with about 2.8 million tons reduction in wheat production and 280,000 tons in barley per year during the drought, as well as the loss of the value of stubble as fodder. Production of alfalfa was down 38%. Many fruit trees (e.g. banana plantations in Sistan and Baluchestan province) have perished and 1.1 million hectares of orchards growing almonds, apricots, mangoes and other fruits have been heavily affected. The drought severely affected the number and productivity of commonly-raised livestock as it reduced the quantity and quality of forage available on rangelands and pastures. Over 85 million head are affected by the drought. Over 200,000 nomadic herders have lost or continue to lose their only source of livelihood and an estimated 800,000 small animals have died due to malnutrition and disease (Keshavarz et al., 2013).

As a result, precipitation pattern including rain and snow will change. Other facts and projections show, warm and dry regions will become warmer and drier (Masoudi et al., 2018).

Since farming is the primary source of income for most farm families, low precipitation and depletion of groundwater has led to a major reduction in income. Less vulnerable families experienced a loss of income due to reduced area of cultivation and because of pest infestation.

Most of less vulnerable families could only cultivate about a third of their land. Resource poor families believed that their production was down by about 60%. The prolonged drought had created significant hardship for them. The very resource-poor families faced many obstacles. Their farm income approached zero. Poor soil, lack of irrigation water, money, tools and equipment intensified their hardship during drought. It is important to note that some of very resource - poor families relied on charitable organizations, like the Imam Khomeini Relief Committee, to survive. Obtaining money from their very limited resources and savings, and the impetus to quit farming as a consequence of the drought, led to an increase in their dependency on government support. Without the assistance of the government and NGOs, many would be in a much more precarious position. As an extreme natural hazard, drought has various impacts at local, regional and national levels, including:

A. Economic impacts: such as loss of farm income and reduced income diversity, increased debt, increased on-farm workload and decreased options for off-farm employment.
B. Basic needs: including food insecurity and health problems due to drought related stresses and lack of income for adequate health care.
C. Education: reduced household expenditure on education, which can especially affect younger members of families who may forego the opportunity to continue their education due to economic constraints.
D. Marriage: an increase in the age of marriage and a change in mate selection criteria.
E. Conflict and dependency: including increased family and social conflict, social isolation and increased dependency on government assistance.
F. Emotional and psychological: including suffering from a sense of hopelessness, failure and loneliness.

These impacts are not the same for all families. This indicated that farm families could be classified into two distinct groups:

A. The less vulnerable and
B. The more vulnerable.

The vulnerable families have suffered more and their resilience has dramatically diminished. It is important to be aware of the gendered and age differential nature of drought and how this plays out in relation to the above impacts. In vulnerable families, some impacts like unemployment, increased on-farm work, malnutrition and hunger, loss of education opportunities, marriage difficulties, social isolation, social and family conflict, depression and hopelessness are disproportionately experienced by women, children and older people.

The limited access to the job opportunities in drought-affected rural areas led to an increase in unemployment, and in some cases, to people seeking work elsewhere. This experience encourages the young people of vulnerable families to want to never return to the farm. This loss of the next generation of potential farmers may lead to an undeveloped form of agriculture that is more vulnerable to future droughts and other natural disasters. Therefore, support should be provided to increase the resilience of young people and to allow them the choice to continue farming in the rural areas (Keshavarz et al., 2013) (Figure 8 and Figure 9).

Figure 8. Floods and their damages that caused loss of valuable water after a long period of drought in South Khorasan province, east of Iran (By author, February, 2012).

Figure 9. Some watershed management projects for saving valuable water of floods for confronting to long periods of drought in South Khorasan province, east of Iran (By author, 2010).

10. Establishing Infrastructures in Rural Regions of Iran

In the late 20th and early 21tt centuries, rural restructuring has been identified in Western Europe, North America, and some countries in the Middle East. At the same time, such transformational development has

also taken place in the rural areas of developing countries, such as China, India, the Philippines, Zimbabwe, and Ecuador. This rapid and radical rural restructuring is often referred to as rural transformation development (RTD). In most developing countries, RTD is usually characterized by changes in agricultural intensity, crop selection patterns, farmland, land productivity and farm income, labor and technological productivity, and major improvements in rural housing and economic and social conditions resulting from industrialization and urbanization. RTD is, in essence, a term that captures changes in traditional rural industries, the employment consumption structure, and the social structure. These changes signify a transformation from previously isolated urban and rural economic structures toward more coordinated urbane rural development. Such transformation radically changes the urban - rural relationship and the relationship between agriculture and industry. On balance, as development proceeds, risk management in rural space should become less needed, and in some sense, easier. Particularly as the private sector develops in its many service roles in rural areas, there will be less need for governments even to ponder intervention for agricultural and other rural development purposes.

RTD assessment involves measuring three major components:

- The development of a distinctively rural economic system;
- The transformation of rural social, economic and consumption structures;
- And the improvement of the urbane rural relationship (Long et al., 2011).

The advantages of diversification or rural development have long been recognized and the newest role of the government has been to encourage and whenever possible assist in these endeavors. Nearly, half of the world's population lives in the rural areas of the developing countries. Rural areas in Iran include vast geographical areas with small towns and villages of one thousand or less in population dotting the landscape. These small communities are necessarily linked to agriculture with very little diversification. These communities are solely dependent upon the fortunes of one or two primary enterprises that are in many cases controlled by actions a thousand kilometers away. This is an extremely tenuous situation and these communities must diversify to insure economic and social viability. The advantages of diversification or rural development have long been recognized and the newest role of the government has been to encourage and whenever possible assist in these endeavors. For that purpose, several electrification and piped-water projects and supporting programs have been undertaken by the Ministries of Energy (MOE). The programs, which attempt to address problems aggravated by the recent war, distance, and low population densities, depend upon the will and determination of the people involved as well as the wise and effective use of energy conversion and distribution technology for success. There are many social and economic benefits that are gained from the use of needed technology for rural energy development in Iran. To realize some of these benefits is an ongoing and changing process that must be sensitive to the specific technology itself and its potential for effective change or improvement (Ardehali, 2006).

Radio, television, media, satellite technologies and improved road and transportation facilities and technologies in relation to agricultural industry in recent years provided in rural areas (Jalalia et al., 2011).

11. Establishing ICT Centers in Rural Regions of Iran

Rural Information and Communication Technology Centers (ICT Centers) play an important role in rural development through improving e-governance in rural areas. ICTs can enable rural communities, particularly in developing nations with an opportunity to meet development goals such as poverty reduction, basic health care, and education far more effectively than ever before. Using ICTs in rural areas for enhancing agricultural production is suggested to be immensely beneficial as most of the poor live in rural areas. Moreover, ICT application in rural areas can give them a voice and improve their employment. International policies always call on under developed countries to create simple tools for local development. In Iran, information technology service-providing centers and centers for rural communications were established thanks to popular support and backing from state-run organizations. 17,000 Tele-centers are currently active and equipping them until 2020 was a major effort of the government of Iran to develop electronic services which can balance cities and villages in cultural, social and economic development. The role of Tele-centers in Gharnabad and East Livan (2 pilot villages in ICTs application in rural development in north of Iran in Golestan province) for improving knowledge in general and making a good media for business development and entrepreneurship is proven. (Jalalia et al., 2011; Golmohammadi, 2012; Iranian Bureau of Statistics, 2021).

12. Main Barriers for Rural Development in Iran

The main factors responsible for slow rural development in Iran are identified as:

A. Lack of understanding for importance of energy (heavily subsidized fossil fuel and electrical energy).
B. Low and inconsistent income (nature of government-supported job market).
C. Lack of proper management and adequate basic infrastructures for energy matters (inadequate legislative support).
D. Uneven development within the country

(investment mainly in the government holdings).

The causes for slow development are inter-related and they form a closed cycle making it difficult to approach problems on individual basis. Of course, the key factor contributing to this phenomenon is the uneven development at the global scale (87% of the economy managed by the government of Iran). The slow development, consequently, results in the rural - urban migration, depleting the rural areas of the valuable manpower resources, as it is commonly conceived that the move to urban areas is a remedy for economic problems found in the rural areas (Ardehali, 2006).

13. Approaches for sustainable rural community development in Iran

Today it is clear that rural communities face with various challenges in achieving a sustainable development. It seems that sustainable rural community development in Iran can be achieved through:

A. Diversification of rural economy and capacity building of rural communities
B. Supporting job creation activities and promoting sustainable tourism, business and industrial activities based on rural social and economic potentials
C. Encouraging people for participating in the process of planning, executing and maintaining rural development projects
D. Establishing an appropriate urban-rural network to serve rural areas by small towns
E. New economic policy needs to be established encouraging micro-enterprise supported by micro-capitals and national policy must secure, protect and improve rural livelihoods
F. A new rural sector strategy has to be prepared that incorporate the following objectives: structural change to the production system, with suitable utilization of productive resources and environmentally friendly technologies, sustainable managed resources; no urban bias in health, education and safe water provision; off-farm income and employment generation; decentralized and participatory decision making; functioning rural markets; and widely shared rural economic growth (Kalantari et al., 2008; Golmohammadi, 2012).

14. Participation of Local People toward Rural Development

Today exploiting the participation and the abilities of local people, particularly rural population, toward rural development has been considered as one of the effective strategies toward sustainable and comprehensive development of rural areas. The most important tool to achieve this goal is establishing NGOs based on the needs as well as abilities of different groups living in the villages, in diverse and essential issues of indigenous and local environment, in order to perform rural developmental programs. These organizations, in economic and social fields – due to avoid a complex public sector bureaucracy and profit making of private sector - made it possible to in such areas as fighting poverty and hunger, environmental protection, forestry, increase awareness general welfare, health, community and family, according to women and children, redacting social damages and act successful than the private and public sectors. Villages in the contemporary developments and threats facing widespread, and therefore ensure continuity of rural life and survival requires solutions and new methods to deal with problems that are innovative, invent, create products, processes and techniques depend on is large. For this purpose, managers must take on roles that are peripheral to suit changing conditions. Thus, rural development compared with the last link with the concept of entrepreneurship has wider. In recent years, the Islamic Councils and rural workers have been defined as the new managerial bodies in villages in Iran. As local people-centered managerial entities that are direct responsible bodies in villages, Rural workers and Islamic Councils can make policies, manage and implement various educational programs, help the development of necessary infrastructures, attract financial resources, and play a major role in the development of rural entrepreneurship, paving the way for the development of rural entrepreneurship in Iran. Essentially, the two factors of entrepreneurship are determined as opportunity and desire to become entrepreneurs. The main factors driving opportunities include: internal entrepreneurial abilities, attempting to investment, market entry and general macroeconomic environment (Golmohammadi, 2012).

15. Measuring Agriculture and Rural Development

Under the emerging rural development paradigm, we argue that to be multifunctional an activity must add income to agriculture, it must contribute to the construction of a new agricultural sector that corresponds to the needs of the wider society and it must reconfigure rural resources in ways that lead to wider rural development benefits. The concept of the multi-functionality of agriculture embraces all goods, products and services created by farming activities. Used for the first time in 1993 by the European Council for Agricultural Law in an effort to harmonize agricultural legislation across Europe and to provide the general notion of ‘sustainable agriculture’ with a legal definition (Marsden et al., 2008).

Issues related to measuring rural development have attracted the interest of a wide variety of researchers. During the 1970s and 1980s, an index of rurality for local government districts in England and Wales was developed to identify some of the differences between degrees of rurality. This index included such indicators as

population, household amenities, occupational structure, commuting patterns, and the distance to urban centers, and was constructed using a range of statistics from the 1971 and 1981 censuses. It is important to note that Paul Cloke (1994) himself has since drawn critical attention to the inappropriate or naive method of indexing and categorizing the rural in this way. He has written extensively on representations of the rural, social constructionist approaches to rurality, and considerations of how the rural is produced by social, cultural, material and economic relations. A similar rurality degree index (RDI) was recently established to distinguish degrees of rurality in eastern coastal China. A corresponding index has also been developed to measure and explain both urban and rural development (Long et al., 2011).

16. Conclusion and Recommendations

The oil industry has been exploited for the past 60 years in Iran. It has been shown that oil and development have direct influence on one another; the fluctuation of oil process, its rise and recession, has a great effect on the nation's developmental trend. Relying solely on nonrenewable energy sources like oil can become a cause of unsustainability by itself. Iran's population has increased and simultaneously the residency pattern has favored the urban areas in the last decade. Urbanism increase is an important index of progress in parallel with the production and growth of economy. However, urbanism evolution in Iran is not the result of social and economic streamlining, rather the intensification of the gap of the expected incomes between urban and rural areas, seasonal drought and the availability of the resources (Bakhoda et al., 2012).

Rural development has traditionally been seen as a vague term that is difficult to specify measure and evaluate. Today's rural economy and its social system are much more diverse, complex, sophisticated and global than those of the last century. Rural development is now seen as a multilevel, multi actor and multifaceted process that requires an understanding of the agricultural developmental model, the relationship between agriculture and society, the regional socioeconomic structure and rural economic status, individual farm households and their behaviors, and local policies and institutions. (Long et al., 2011).

Iran is a nation with strong rural roots. Despite rampant urbanization, about 25% of its population still lives in rural areas, and the national economy has been built on agricultural foundations since ancient times. Currently, both rural development and urban development in Iran are experiencing a transition period. Since the overcoming great Islamic revolution in 1978, the Iranian central government has focused significant attention on substantially improving rural residents' well-being and achieving the coordinated development of urban and rural areas. Improving rural residents' well-being is a popular and political concern in Iran (Golmohammadi, 2012; Iranian Bureau of Statistics, 2021).

Rural areas in Iran are necessarily linked to agriculture with very little diversification. These communities are solely dependent upon the fortunes of one or two primary enterprises. This is an extremely tenuous situation and these communities must diversify to insure economic and social viability (Ardehali, 2006).

A useful theoretical approach to rural development considers how local factors and external driving forces interact to determine the development of the rural economic system. This relationship between the local, rural system and the external system in particular, the links between the rural and urban economies and cultures are important strands in current rural development research. For instance, rural agricultural development has been seen to play an important role in regional industrialization and urbanization by guaranteeing the supply of food and raw materials needed to sustain industrialization. This kind of role, in turn, leads to the transition and transformation of rural areas (Long et al., 2011).

Overall situation in economic challenges indicates that the rural economy in Iran is too much depending on agriculture. The poor agricultural infrastructure and lack of forward and backward linkages, that hinders the development of other industries, are the main obstacles towards diversify and sustainable economic development of Iranian rural communities. Lack of indigenous and appropriate theoretical framework and coherent strategy for sustainable rural development accompanied by centralized planning system indicates basic management and planning challenges which create pronounced obstacle for involving people in planning process. People participation in local management system and planning process should become in the core of development plans and this requires decentralization of planning system for rural areas. In the process of decentralizing, rural areas should have higher level of authority to participate in planning process. Environmental challenges are emerged in the form of overexploiting of underground water resources and use of unsuitable technology in agricultural sector. As Iran is located in arid and semi-arid areas, there is a growing risk of droughts in most parts of the country, which will further slowdown the economic performance of the country in general and agricultural sector in particular. This indicates that ecological and environmental sustainability should be considered in policy making and planning system in Iran.

Wide dispersion of rural settlements accompanied by insufficient population threshold indicates physical challenges for rural areas in Iran. This pattern of settlement system does not allow providing any social services as well as diversifying economic activities in many rural areas. Finally, absence of rural-urban linkage and inability to localize these linkages is one of the greatest challenges in promoting a more dynamic process of rural-urban development in most provinces in the country. Due to lack of such policy, disparities occur, as

higher value added in processing is captured in national core metropolitan regions. This phenomenon not only creates a fundamental barrier for achieving sustainable development, but generates a deep rural urban disparity in the country (Golmohammadi, 2012).

Despite considerable achievements in the provision of basic developmental facilities in terms of drinking water, access to primary healthcare services, high-quality and nutritious food, social services, and proper housing facilities, there are many rural and slum communities in Iran where these essential needs remain unfulfilled. Lack of equity is prominent, as large differences exist in underprivileged provinces. New policies developed in the past two decades have resulted in substantial achievements in meeting population needs and reducing the socio-economic gap; nevertheless, poverty levels, unemployment due to a large increase in the birth rate in the early 1980s, and lack of community participation are matters yet to be addressed. To overcome these deficiencies, a basic development needs approach was adopted to promote the concept of community self-help and self-reliance through inter-sectored collaboration, creating an environment where people could take an active part in the development process, with the Iranian government providing the necessary support to achieve the desired level of development (Asadi-Lari et al., 2005).

In order to increase the prospects for return migration changes need to take place within rural communities, none more so than the creation of employment opportunities consistent with the individuals' level of qualifications. Of course in - and return migration indirectly stimulate demand for rural services, among other things, and consequently contribute to the survival of depopulating communities. However, if these communities are to do more than merely survive, greater economic regeneration is required. It is for these reasons that a rural endogenous development policy on its own will have limited success in regenerating depopulating areas. The fact that some of the respondents have created jobs indicated that some level of regeneration is taking place, but this needs to be intensified.

Development policies need to assist and in particular more fully take account of the migration processes operating in rural peripheral areas in Iran. Initially, at least, it is suggested that the emphasis will need to be on exogenous development creating the economic opportunities to encourage return and in-migration flows. Equally important retention policies will be required. Economic programs should not override the fact that the objectives for economic development must still originate from within the local community.

Exogenous measures of support should therefore enable rural communities to achieve their goal of economic regeneration. While at a national level government and academic attention is focusing on population dynamics and positive migration policies, one should not forget that the current national problems of population decline and ageing have existed among some rural communities for a considerable time. The introduction of national migration policies should also be accompanied by positive rural migration policies, especially for depopulating peripheral areas. Such policies should aim to encourage the immigration, return and retention of much needed human capital to enable endogenous development. It is also incompatible with the need to move to acquire the relevant skills and experience to contribute to endogenous development. Various researches have demonstrated that quality of life perceptions are important in attracting migrants with business ideas. Addressing the quality of life perceptions associated with declining peripheral areas may do much to encourage the inflow of those with job creation and economic regeneration potential in Iran (Stockdale, 2006; Golmohammadi, 2012).

Author Contributions

All task made by single author and the author reviewed and approved the manuscript.

Conflict of Interest

The author declared that there is no conflict of interest.

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Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.1013027

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 5 - Issue 1: 40-43 / January 2022

THE EFFECTS OF ORDER OF LACTATION ON MILK COMPONENTS IN WATER BUFFALO RAISED IN SHEEP BREEDING RESEARCH INSTITUTE

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Abstract: This study was make in order to determine according to the order of lactation, the composition of milk, Murrah x Anatolian Water Buffaloes (M x A) crossbreds raised in Institute conditions. The animal material consisted of total of 47 heads M x A crossbreeds cows. The data of the study included between February 2016 - January 2018. Actual milk yield was used to determine average lactation length and lactation milk yield. Milk samples were taken to specify the milk components. The fat, nonfat dry matter, protein, and lactose contents of water buffalo milk samples were determined by using a Funke Gerber® milk analyzer. Lactation length and lactation milk yield were found to be 259 days and 1343.14 liters respectively. The least square means were found fat, nonfat dry matter, protein, and lactose, 7.20%, 10.66%, 4.00%, and 5.88% respectively. The milk yield in the first and second lactations of G2 (M x A) crossbreeds and Murah genotype were higher than others in the present study. A negative correlation between milk yield and milk fat is expected. Although not statistically significant, a negative correlation was determined as expected.

Keywords: Water buffalo, Anatolian, Murrah, Milk component

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Received: October 21, 2021
Accepted: November 17, 2021
Published: January 01, 2022

Cite as: Cetin I, Sevim S, Yuksel MA. 2022. The effects of order of lactation on milk components in water buffalo raised in Sheep Breeding Research Institute. BSJ Agri, 5(1): 40-43.

1. Introduction

Domestic buffalo, called "Water Buffalo" belonging to the species Bubalus bubalis; is divided into two different types, namely River and Swamp Buffalo (Şekerden, 2000; Atasever and Erdem, 2008; Özkan et al., 2017). While swamp buffaloes generally benefit from draft power and meat yield, river buffaloes gained value in terms of both meat and milk yield characteristics (Soysal, 2006).

River buffaloes (Bubalus bubalis) are distributed in almost every region of the world, from America to Asia, due to their ability to adapt to various climatic and topographical conditions. It was brought to Europe from Asia in the Middle Ages with the Crusades, and it has been cultivated in terms of milk yield characteristics from West India to Egypt and even to Europe, as well as providing the formation of Italian and Bulgarian buffaloes that are cultivated today (Soysal, 2006).

The buffalo population in the world is 200967747 heads, and approximately 97.415% of this is in the Asian continent. Although India, Pakistan, and China are the top 3 countries with the highest number of buffaloes globally, India has approximately 56% of the world's buffalo population (Anonymous, 2019). As in the number of buffaloes, it is stated that the main dairy breeds of India and Pakistan, which produce the most in terms of milk production, are Murrah, Nilli-Ravi, Surti, Mehzana, Nagpuri, and Jaferabadi (Subasinghe et al., 1998). India has the best buffalo breeds in the world and the economic value of buffalo milk is relatively high. Between 2017 and 2018, it is seen that there was an increase of 0.77% in the number of animals and 6.44% in milk production (Anonymous, 2019).

Turkey, the Anatolian Buffalo is bred as a buffalo species. Due to the lack of importance given to water buffalo breeding in the past years, a significant decrease in the number of animals was observed until 2010. In the period between 2006 and 2010, the number of buffaloes decreased to 84726 heads. Since 2011, thanks to the Ministry of Agriculture and Forestry projects, the number of animals and milk production has increased more than twice (Anonymous, 2020). Buffalo milk production increased from 40372 tons to 70341 tons between 2011 and 2019.

Milk plays an important role in human nutrition. Buffalo milk is of great importance in human nutrition due to its rich content compared to other milk. Components of buffalo milk are affected by factors such as breeding, feeding, season, lactation order and lactation period. It also varies according to the lactation week (Şekerden et al., 1999; Zava and Sansinena, 2017).

Compared to cow's milk, buffalo milk; has a high solid matter, fat and protein content, and its main components

are fat, protein and lactose. Depending on the saturated fatty acids in milk fat, there are differences between fat's consistency, freezing, and melting points (Özkan et al., 2017). Gürsoy (2020) stated that the dry matter, fat, protein, lactose and ash contents of buffalo milk are 17.2%, 7.4%, 3.5%, 5.4%, 0.8% respectively; that the mentioned components of bovine milk are 12.6%, 3.7%, 3.4%, 4.7%, 0.7% respectively. Şekerden (2016) states that studies have concluded that the higher fat content in buffalo milk compared to other milk has not adversely affected digestibility. The water content is lower (Cockrill, 1974).

This study was carried out to determine the variation of some components of M x A crossbreeding buffalo milk grown under the conditions of the Sheep Breeding Research Institute within the scope of the "Breeding of Anatolian Buffalo Project" according to the order of lactation.

2. Materials and Methods

2.1. Animal Materials

The material of the study consisted of the data obtained from 47 M x A crossbreeding cows raised in the Sheep Breeding Research Institute and gave birth from February 2016 to January 2018. No changes were made in the breeding and feeding practices of the animals. Actual milk yield records were used to determine lactation period and the lactation milk yield.

To determine the milk components, the sampling process was carried out in 30-day periods. 50 cc milk samples were taken from each animal's morning and evening milking, mixed, and brought to the laboratory in the cold chain. Analyzes were performed on the day the samples were taken. This study; used Funke Gerber® milk analyzer to determine milk fat, non-fat dry matter, protein and lactose content.

2.2. Statistical Analysis

The obtained data were evaluated using to the least squares method, using the SPSS 25.0 package program (SPSS 2015).

3. Results

Lactation duration and lactation milk yield, which are considered within the scope of the research, are given in Table 1, the averages of lactation order and milk components are shown in Table 2, and the correlations between milk yield and milk components are shown in Table 3. Lactation duration and lactation milk yield averages, respectively were determined as 259 days and 1343.14 liters.

Table 1. Least squares mean of lactation duration and lactation milk yield

Lactation order	n	Lactation duration (Day) Mean	Lactation milk yield (Liter) Mean ± SE
1	9	277	1255.33 ± 133.880
2	18	248	1489.13 ± 74.852
3	8	267	1315.18 ± 110.272
4	12	251	1208.66 ± 68.639
Overall mean	47	259	1343.14 ± 48.014

Table 2. Least squares mean of lactation order and milk component

Lactation order	Fat (%)		Nonfat dry matter (%)		Protein (%)		Lactose (%)	
	n	Mean±SE	n	Mean ±SE	n	Mean ±SE	n	Mean ±SE
1	9	7.01 ± 0.288	9	10.61 ± 0.111	9	3.96 ± 0.43	9	5.81 ± 0.58
2	17	7.11 ± 0.234	18	10.70 ± 0.106	18	4.02 ± 0.45	18	5.90 ± 0.61
3	8	7.18 ± 0.349	8	10.43 ± 0.190	8	3.94 ± 0.79	8	5.82 ± 0.117
4	12	7.49 ± 0.149	12	10.79 ± 0.117	12	4.05 ± 0.47	12	5.96 ± 0.65
Overall mean	46	7.20 ± 0.124	47	10.66 ± 0.064	47	4.00 ± 0.26	47	5.88 ± 0.036

Table 3. Correlations between milk yield and milk components

	Milk yield	Lactose	Protein	Nonfat dry matter	Fat	Lactation order
Lactation order	0.163	0.168	0.120	0.080	0.202	1
Fat	-0.05	0.540*	0.565*	0.482*	1	
Nonfat dry matter	0.113	0.898*	0.926*	1		
Protein	0.067	0.988*	1			
Lactose	0.057	1				
Milk yield	1					

*P<0.05

In the first lactation order, although the lactation period was the longest, was obtained the highest milk yield from the buffaloes in the second lactation. The effect of lactation order on lactation duration and lactation milk yield is statistically nonsignificant. Buffaloes during the 1st and 2nd lactations; as it is a Murrah and G2 (M x A) cross, milk yield was higher than in other lactation order cows.

In this study; Milkfat, non-fat dry matter, protein, and lactose content were highest in animals in the 4th lactation order. Observed that only the fat content increased regularly depending on the progression of the lactation order. The results of the analysis carried out to determine the milk composition are given in Table 2. However, it was concluded that lactation order did not significantly affect on milk composition ($P < 0.05$).

As seen in Table 3, milk yield and milk fat; Although not statistically significant, a negative correlation was found as expected. The negative correlation is expected to increase with the increase in milk yield and material number following the breeding program.

4. Discussion

According to Özkan et al. (2017), the average dry matter content of buffalo milk is around 17%, of which approximately 7% consists of fat. Towards the end of lactation, along with the decrease in milk yield, an increase dry matter occurs and the fat ratio rises to 10-15%. Mahmood and Usman (2010) reported the content of fat, protein and lactose in buffalo milk as 7.97%, 4.36% and 5.41%, respectively.

In the study we carried out; it was seen that the effect of lactation order on milk components was statistically nonsignificant. When our results are compared with the results of different researchers; the fat and protein content is lower than the values obtained by Mahmood and Usman (2010), while the lactose content is high. Similarly, the fat and protein contents were lower than Şekerden et al. (1999), Ariota et al. (2007) and Şekerden and Avşar (2008).

Lactation sequence does not effect on any component; Şekerden et al. (1999) is similar to the report. According to Afzal et al. (2007), "Lactation milk yield increased with increasing lactation length", but these results obtained in the study, Afzal et al. (2007) are not similar to their findings.

The changing of lactation duration according to lactation order is not similar to the findings obtained by Ilieva and Peeva (2007) in the study they conducted in Bulgarian Murrah buffaloes. As a result, lactation orders has no effect on lactation length, yield, and milk components. The results are likely to change as animal material increases depending on the "Breeding of Anatolian Buffalo Project".

Author Contributions

All authors contributed equally to the study and reviewed and approved the manuscript.

Ethical Approval

A retrospective ethics permit is not required for the articles, which were produced from used master/doctorate or research studies before 2020.

Conflict of Interest

The authors declared that there is no conflict of interest.

Acknowledgments

The data obtained within the scope of the "Breeding of the Anatolian Buffalo" project numbered TAGEM/HAYSÜD/G/21/A4/P1/2720 supported by the General Directorate of Agricultural Research and Policies were used. The study was presented as a poster at the 1st International Livestock Science Congress, Antalya, 31 October - 01 November 2019.

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Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.1012105

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 5 - Issue 1: 44-47 / January 2022

SCREENING FOR GALWAY MUTATION (*FECX^G*) IN KIVIRCIK BREED

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Abstract: High litter size or twinning is an economically important trait that enhances sheep productivity. The *FecX^G* has been influentially associated with the ovulation rate in various sheep breeds. However, there is limited information about this locus in the Kivircik sheep breed. Therefore, the aim of this study was to evaluate the presence of the Galway (*FecX^G*) mutation in Kivircik sheep (n=91) raised in Kirklareli province. Genomic DNA was isolated from whole blood using the phenol-chloroform extraction method. The genotyping was performed by the PCR-RFLP method. Results revealed that all ewes had the Galway mutation (*FecX^{GG}*) and the corresponding genotype was fixed in the studied population. The present analysis showed that the Galway mutation which is a nucleotide alteration (cytosine to thymine) at position 718 bp of the *BMP15* (also known as *FecX*) gene may be considered in enhancing twinning in the Kivircik breed. However, further analyses with larger populations are needed to confirm the present results and to provide more detailed information before focusing on this genomic region in breeding programs for purebred Kivircik sheep.

Keywords: Sheep, Kivircik, *FecX^G*, Mutation, Polymorphism, PCR-RFLP

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Received: October 19, 2021
Accepted: December 02, 2021
Published: January 01, 2022

Cite as: Cobanoglu O, Ardicli S. 2022. Screening for galway mutation (*FecX^G*) in Kivircik breed. BSJ Agri, 5(1): 44-47.

1. Introduction

The transforming growth factor-β (*TGF-β*) gene superfamily encodes multifunctional proteins that play fundamental roles in cell growth and differentiation (Kumar et al., 2008). These proteins have also important effects on embryogenesis in mammals. *TGF-β* consists of fecundity genes in sheep, including bone morphogenetic protein receptor IB also known as Booroola fecundity gene (*FecB*), growth differentiation factor 9 (*GDF9*) also known as *FecG*, and bone morphogenetic protein 15 (*BMP15* or *GDF9b*) also known as *FecX* (Galloway et al., 2000; Wilson et al., 2001; Hanrahan et al., 2004; Kumar et al., 2008). The mutations in two oocyte-derived growth factor genes including the X-linked *BMP15* (*FecX^G* and *FecX^B* mutations), and *GDF9* (*FecG^H* mutation) have been associated with the exceptional prolificacy in Romney, Belclare, Cambridge, and Lacaune breeds (Mullen et al., 2013). *BMP15* maps to the X chromosome and is specifically expressed in the oocytes. The BMP15 mRNA in the sheep ovary is only expressed in oocytes, and its encoded product plays an important role in oocyte development (Niu et al., 2021). Mutations in this gene [Inverdale (*FecX^I*), Hanna (*FecX^H*), Belclare (*FecX^B*), Galway (*FecX^G*), and Lacaune (*FecX^L*)] have been influentially associated with ovulation rate in various sheep breeds (Galloway et al., 2000; Hanrahan et al., 2004; Kumar et al., 2008). Among these mutations, the Galway mutation is a nucleotide alteration (C to T) at position 718 bp of the *BMP15* gene, which introduces a premature stop codon in place of glutamic acid at amino acid residue 239 of the unprocessed protein (Kumar et al., 2008).

All heterozygous ewes exhibit higher prolificacy than wild-type genotypes. The mutant type had a non-additive effect on ovulation rate, and accordingly, the homozygotes are sterile (Galloway et al., 2000; Hanrahan et al., 2004). Based on the X-linked inheritance, rams carry only one copy and pass it to all daughters.

Kivircik sheep breed is one of the most important native livestock genetic resources of Turkey. It is a thin-tailed breed and its meat is preferred widely by the consumer because of superior meat quality characteristics (Gurcan et al, 2018). There is limited information about this fecundity gene in the Kivircik sheep breed. Taken together, this research was designed to evaluate the presence of the Galway (*FecX^G*) mutation which is suggested to be associated with a high ovulation rate in Kivircik sheep.

2. Materials and Methods

2.1. Animal Material and DNA Extraction

The study was conducted on a total of 91 purebred Kivircik ewes raised in Kirklareli province, Turkey. The animals were recorded for the Pedigree Project of the Turkish Ministry of Food, Agriculture and Livestock, and Cattle Breeders Association. All animals were housed and managed according to the standard farm procedures. Blood samples (~4mL) were collected in Vacutest tubes

with a K_3EDTA (0.2 mg/mL) anticoagulant (Vacutest Kima SRL, Arzergrande, PD, Italy). Genomic DNA was isolated using the standard phenol-chloroform method as described by Green and Sambrook (2012). The concentration of total DNA samples obtained and their quality was estimated using a NanoDrop 2000c spectrophotometer (Thermo Scientific, USA).

2.2. PCR-RFLP Analyzes and Genotyping

The Galway (*FecX*^{G}) mutation was screened in Kivircik sheep by the PCR-RFLP. The primers used in the amplification of the target gene region was presented in Table 1. The amplification of genomic DNA was carried out with a total volume of 25 µL in PCR reaction, including 1 µL (0.025 µM) of each primer (forward and reverse), 12.50 µL PCR master mix (OneTaq Quick-Load 2x MM with Standard Buffer, New England BioLabs Inc., Ipswich), 3 µL of the purified DNA sample, and 7.5 µL of nuclease-free water (Thermo Scientific). The PCR amplification program was 94 °C for 5 min, 35 cycles of 94°C for 30 s, 62.3°C for 30 s, 72°C for 45 s, and a final extension of 72 °C for 5 min. 10 µL of amplified PCR products were digested with *Hin*fI restriction enzyme *(*Thermo Fisher Scientific Inc., USA) at 37°C for about 4 h to determine the allelic polymorphism.

Table 1. Primers sequences (from 5' to 3') for Galway mutation (*FecX*^{G})

Primer sequences	Reference
F: CACTGTCTTCTTGTTACTGTATTTCAATGAGAC R: GATGCAATACTGCCTGCTTG	Hanrahan et al., 2004

F= forward, R= reverse.

Briefly, PCR amplified and digested DNA fragments were separated on 2% and 3% agarose gels, respectively, and stained with ethidium bromide. The gels were scored for the presence or absence of the mutations by a gel imaging system (DNR-Minilumi, DNR Bio-Imaging Systems, Israel). In this respect, the PCR product from noncarriers (wild type genotype) has a *Hin*fI site, while carrier individuals (mutant genotype) lack this restriction site. After digestion, wild type individuals (*FecX*$^{++}$) should have 111 bp and 30 bp fragments, heterozygotes should have (*FecX*$^{G+}$) 141 bp, 111 bp, and 30 bp fragments, and homozygous individuals (*FecX*^{GG}) are recognizable with an uncut 141 bp fragment (Kumar et al., 2008).

2.3. Statistical Analysis

The *FecX*^{GG} genotype was fixed in the studied animals. Hence population genetics parameters and Hardy-Weinberg equilibrium could not be estimated.

3. Results and Discussion

In small ruminant breeding, there has been increasing interest in the evaluation of prolificacy (Gedik, 2021). The trends in selection procedures have gradually changed from traditional phenotype-based applications to genotypic considerations by the identification and utilization of major genes for prolificacy (Davis, 2004). The Booroola Merino was the first breed in which ovulation rate and litter size were shown to be affected by a segregating major gene in sheep (Piper et al., 1985). It was demonstrated that *FecB*, which is a dominant autosomal gene, has an additive effect on ovulation rate. On the other hand, an X-linked gene was associated with an increase in the ovulation rate and it was first described in Romney sheep and named the Inverdale gene (*FecX*). It is important to note that homozygous carrier females exhibit sterility. Therefore, this gene has been suggested to be a pivotal genetic marker for prolificacy in sheep (Davis, 2004).

This study focuses on the analysis of the Galway mutation (*FecX*^{G}) in the Kivircik breed which is one of the most important sources of Turkey's national livestock. In this sense, the 141 bp fragment in the *BMP15* gene [genomic location: X: 56594565-56601245 (-)] was amplified (Figure 1).

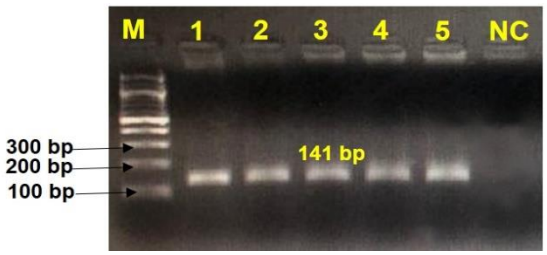

Figure 1. The electrophoresis pattern of PCR amplification for the Galway mutation (FecXG). M: Marker (100 bp).

In the present analysis, all animals remained undigested with the *Hin*fI restriction enzyme (Figure 2). This suggests that Kivircik sheep were found to be *FecX*^{GG} genotype. Hence, the corresponding genotype was fixed in studied ewes, and accordingly, population genetics parameters and Hardy-Weinberg equilibrium could not be estimated.

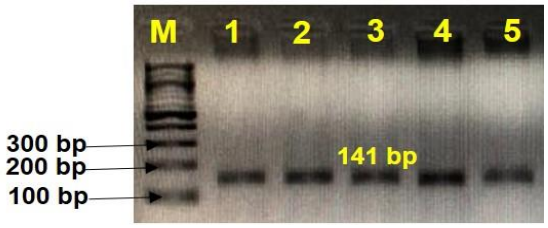

Figure 2. The electrophoresis pattern of restriction enzyme digestion of PCR product with *Hin*fI for the Galway mutation (*FecX*^{G}). M: Marker (100 bp). The PCR product remained undigested, and hence, all ewes were genotyped as (*FecX*^{GG}).

This result demonstrated that admissible prolific characteristics of the Kivircik breed can be partially explained by the presence of the *FecX*^{G} mutation. However, it is worth noting that, undigested fragments in the PCR-RFLP analyses may cause unreliable or controversial results. To overcome this limitation, RFLP analysis was performed in duplicate in this study.

High litter size or twinning is a crucial economically important indicator that determines the productivity of the herd, concerning the number of lambs, meat, and wool (Ardicli et al., 2021). The presence of *FecX*^{G} mutation has been shown to be an important genetic factor to achieve high prolificacy in sheep (Davis, 2004; Kumar et al., 2008). Concerning different breeds of sheep, the results of *FecX*^{G} mutation analyses revealed mostly controversial suggestions. But this situation is a common circumstance in genotypic evaluation. Different breeds or different individuals of the same breed may exhibit distinctive genotypic distributions. Hereupon, previous analyses revealed remarkable differences in genotypic frequencies in various breeds of sheep. Gursel et al. (2011) found that all of the investigated Kivircik sheep were heterozygous for the *FecX*^{G} locus. These researchers suggested that Kivircik, Imrose, Awassi, and Chios breeds had an advantage for fertility due to heterozygosity for *FecX*^{G} mutation. Moreover, the *FecX*^{G} mutation was identified in Belclare and Cambridge sheep (Davis, 2004). On the other hand, Dincel et al. (2015) suggested that the high prolificacy of the Sakiz breed does not result from *Fec*^{B}, *FecX*^{G}, and *FecX*^{I} mutations. Another important point is that the presence of inbreeding should be considered when evaluating the variability in litter size among different sheep breeds (Doekes et al. 2021; Tao et al., 2021).

There are certain limitations to the genetic studies conducted on native sheep breeds in Turkey. On one hand, unconscious crossbreeding and importation have resulted in a decrease or loss of diversity in Turkish native sheep breeds without genetic characterization. This situation has also resulted in difficulties in finding purebred individuals. On the other hand, population sizes or the number of genotyped individuals in these studies are quite low, similar to those in the current study. These limitations prevent providing reliable suggestions or achieving the concrete data to use in gene-assisted selection. Moreover, pedigree data is mostly far from trustworthiness to be applicable in sheep breeding management. Kivircik breed is one of the most important native livestock genetic resources of Turkey and its meat is preferred widely by the consumer because of superior meat quality characteristics. Hence, further molecular genetic analyses should be performed in larger populations.

4. Conclusion

The present analysis showed that all ewes were the Galway mutation (*FecX*^{GG}) carriers. This suggests that selected Kivircik individuals have an advantage for fecundity due to the desired genotype. Consequently, ovine *FecX*^{G} may be considered to achieve high litter size in the Kivircik breed. Nevertheless, the other fecundity genes should be analyzed.

Author Contributions

All authors had equal contributions and all authors reviewed and approved the manuscript.

Ethical Approval

The experimental procedures were approved by the Local Animal Care and Ethics Committee of Namik Kemal University, Tekirdag, Turkey, ensuring compliance with EC Directive 86/609/EEC for animal experiments (NKUBAP.00.24.YL.11.01).

Conflict of Interest

The authors declared that there is no conflict of interest.

Acknowledgments

This study was presented in V. International Congress on Domestic Animal Breeding, Genetics and Husbandry - 2021 (ICABGEH-21).

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Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.983345

Open Access Journal
e-ISSN: 2618 – 6578

Review
Volume 5 - Issue 1: 48-52 / January 2022

FUNGAL DISEASES IN FISH

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Abstract: Fungal diseases of fish have become increasingly important, over the past 20 years. The traditional "fungi" are comprised of members from several different taxonomic kingdoms. An increasing number of other environmental fungi are being reported from diseased fish, further testament to the opportunistic nature of many fungi. Active fungal agents living in waters cause infections in juvenile and adult individuals in fish populations, leading to decay in eggs and larvae. Fungal infections that are generally observed as a secondary infection in fish populations become established in lesions caused as a result of mechanical injury by bacterial, viral, and parasitic primary agents, consequently causing a change in the prognosis of the disease. Fungi, however, can cause disease under a variety of other circumstances. Some may be more aggressive and play a more primary role. Fungi can be external or internal, and systemic. Fungi can cause problems during reproduction, for example, by infecting fertilized eggs in spawns. Certain species of fungi can grow in poorly stored feeds and produce mycotoxins. Fungal diseases, in general, are very difficult to control or treat once they have taken hold. Prevention is, as always, the best medicine. Increased knowledge of basic biology will help guide treatment and control methods. This review study sought to provide insights into the fungal diseases of wild or farmed fish introduced onto the market.

Keywords: Fish, Fungi, Mycotic diseases

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Received: August 16, 2021
Accepted: October 07, 2021
Published: January 01, 2022

Cite as: Özcan F, Arserim NB. 2022. Fungal diseases in fish. BSJ Agri, 5(1): 48-52.

1. Introduction

The ever-increasing world population has led to increasing demand for protein, a condition that has generated a growing interest in fish meat as a source of rich protein. Fish farming is of great importance in meeting a particular part of the need for fish meat. Data published by FAO in 2020 indicate that the total aquaculture production in the world has reached an amount of approximately 178.5 million tonnes (FAO, 2020). The aquaculture production in Turkey, on the other hand, amounts to 314.537 tonnes, with the rainbow trout (*Oncorhynchus mykiss*) produced in inland waters having the greatest quota in the production with 103.192 tonnes (TUİK, 2018). The total global production of this species, on the other hand, amounts to 848 thousand tonnes. Rainbow trout production represents circa 50% of the total fish production in Turkey (TUİK, 2019). The problems producers experience in aquaculture production also lead to economic losses, inflicting financial and moral damages on enterprises (Yilmaz et al., 2011). It is a fact that diseases account for most of the burden arising from monetary losses. Fungal infections represent an essential part of fish diseases. There is a considerable amount of literature on fungal diseases in fish (Silphaduang et al., 2000; Rand et al., 2000; Blaylock et al., 2001). It is of prime importance to define and isolate the related agent to understand the biological characteristics of fungal disease and diagnose and treat it. The present review study sought to provide insights into the fungal infections that afflict fish populations.

2. Saprolegniasis

Saprolegniasis is the most frequently seen and economically most significant disease caused by fungi. It is also called winter fungus or winter kill syndrome (Durborow et al. 2003). It is known that *Saprolegnia* has approximately 14 genera and between 126 and 146 species, among which *S. parasitica* and *S. invaderis* are the most common. It is the fungal disease most frequently seen in freshwater and marine fish populations (Yarsan, 2020). The Saprolegnia genus members belonging to the Oomycete family cause a disease called Saprolegniasis (Beakers et al., 1994; Roberts, 1989). Most of the fungal infections that affect fish are categorized as opportunistic invasive infections. Adverse environmental conditions and stress lead to suppression in the immune system. With excessive mucus secretion, fungi begin to settle secondary to bacterial and viral infections (Khoo, 2000). However, it has been observed that some Saprolegnia species cause fatal and primary diseases, especially in catfish. Saprolegnia is ubiquitous in freshwater ecosystems. It damages the epidermal tissues in fish and can spread to

the whole body, starting from the head and fins (Kutama et al., 2013). Among the Saprolegnia species, *S. parasitica* is a highly virulent species that cause extensive fish kills and decay in eggs in salmon and trout farming (Jiang et al., 2013). The disease's lesions manifest themselves in the skin, gills, and especially in fish eggs in the form of a cotton wool puff (Figure 1).

Fungi colonies consist of heavily branched filaments called hyphae. Many hyphae form a fungus network called mycelium (Yarsan, 2020). As the mycelium is the vegetative part through which a fungus absorbs nutrients, lesions in diseases can be of different colours due to mycelia. Since mycelia feed on algae, they may appear red and brown. First attacking the gill, *Saprolegnia* moves on to infect the eye, brain, liver, spleen, kidney, and swim bladder (Neish and Hughes 1980; Ferguson, 1989). Research has reported limited success in treatment. Water quality, particularly water temperature, is vital in dealing with the disease. Environmental conditions should be improved, and egg and pond disinfection should be performed.

Figure 1. Saprolegnia infections (Chesser, 2020).

3. Aphanomycosis (Epizootic Ulcerative Syndrome)

Aphanomyces was first described by Bary in 1860 and was included in the Leptoleniaceae family by Dick et al. (1999) due to its morphological similarity to this family. It includes about 45 zoopathogenic species found in freshwaters and marine environments. The most reported species are *Aphanomyces invidans* infecting fish populations, and *Aphanomyces astaci* that are mainly observed in arthropods. *Aphanomyces invidans* that is the causal agent of Epizootic Ulcerative Syndrome (EUS) causes mortality up to 100% in aquaculture (Figure 2). It was first defined in Japan in 1971 (İberahim et al., 2018). Research reports that 87 fish species have so far been affected by EUS (Kamilya and Baruah 2014). It is seen more frequently in juvenile individuals than in adult fish (Pagrut et al., 2017). Normally, the skin of fish has the function of a defense system. But changes in environmental factors that lead to lower pH and lower oxygen content influence the defense system, leading to the suppression of the immune system and consequently to EUS epidemic in some cases (Kiryu et al., 2005). Infections begin with the attachment of motile zoospores to damaged areas. The hyphae, composed of zoospores, deeply invade the lower tissues, causing excessive ulceration and destruction in the tissue. The occurrence of skin lesions varies depending on the fish species. Mildly infected fish show only minor inflammation without external lesions, but also petechial haemorrhages in the body, mouth, as well as on the anal fin and exophthalmos (İberahim et al., 2018). Ulcers appear as white areas on the fish's skin, which turn entirely red with a reddish center and later cause external factors. As the disease progresses, the eyes protrude, the body decays, and in some cases the head is eroded, resulting in the death of the fish depending on the severity of the disease (Podeti and Benarjee 2017). Although *Aphanomyces invidans* is the causal agent of EUS, it can be isolated from fish infected with other pathogenic viruses (mostly rhabdovirus), bacteria (mainly *Aeromonas hydrophila*), or parasitic protozoans with *A. invadans* (Huchzermeyer et al., 2012). These infections cause stress in fish and can render them more vulnerable to diseases. Malachite green is important in treatment. It has, however, been prohibited worldwide as it affects the environment and people working in the enterprises in the sector. It is a disease difficult to treat; it is, therefore, important to provide proper nutrition, ideal stock ratio, and optimum water quality conditions (İberahim et al., 2018).

Figure 2. Ulcers on the lateral and fins due to EUS effect (FAO, 2020; Huchzermeyer et al., 2012).

4. Branchiomycosis (Gill Rot Disease)

Branchiomycosis is a much-feared fungal disease in fish farms (mainly in carp farms) and is in the gill epithelium and capillaries. This fungal disease, called gill rot, generally causes high fish mortality, being acute in some freshwater fish (Judy, 2010) It is usually seen in regions with a hot climate (Ramaiah, 2006) Water temperature, the amount of organic matter, and the high amount of ammonia in the ponds fertilized with organic fertilizers are the critical factors that fundamentally influence the prognosis of the disease. Branchiomycosis is an acute infection of the gills that can cause high mortality and respiratory distress in Koi, eel, perch, and many freshwater fish species. It is also called gangrenous bronchitis. Cases have been reported in Europe, Taiwan, and the USA. There are two agents isolated from this disease (Noga, 2010).). While *Branchiomyces sanguinis* and *B. demigrans*. *B. sanguinis* affect carp and tench populations, *B. demigrans* mainly affects the populations of pike, sea bass, and tench (Riad et al., 2015). The two species have significant distinguishing features. *B. demigrans* can multiply and spread outside the blood vessel. It differs from *B. sanguinis* in that it has thicker hypha walls and larger spores (Patel et al., 2018). Both species are seen in fish in environments with low dissolved oxygen and low pH (5.8-6.5) as well as in those being under stress. Respiratory distress, loss of appetite, weakening of movements, and lack of feed are observed in infected fish. This disease, which manifests itself with the necrosis of the gills in fish, causes respiratory distress in the infected gills and is characterized by high mortality due to fungal spores falling from necrosed gills (Figure 3) (Adeshina et al., 2019). There is no cure for branchiomycosis. Dead fish must be removed from ponds and disposed of. Surviving fish are carriers of the infection and should never meet with intact fish in any way (Lio-Po and Lim 2002, Chalmers, 2003). Poor environmental conditions do constitute a vital stress factor for Branchiomycosis induction in infected fish. Water quality parameters, predominantly temperature, dissolved oxygen, and nitrogenous wastes, should be kept at optimum values (Ali, 2005).

5. Ichtyosporidis (Swinging Diseases)

It is a chronic, systemic granulomatosis internal fungal disease, which is endemic in both freshwater and marine fish and is mainly seen in trout. The causal agent of the disease is *Ichthyophonus hoferi* (Choudhury et al., 2014). The disease was first described by Hofer in 1893 in brown trout. Cases have been reported in more than eighty fish species (Zadeh et al., 2014). The agent develops in low water temperatures. The optimum water temperature likely to favor the development of the disease has been reported as 10 °C. The spread of the disease occurs through dead and infected fish, fungal cysts in the feces and cysts free in the water, and foods containing fungi. Internal nodules arise primarily in the skin and tail region (Figure 4) (Govind et al., 2012). An emery-paper-like appearance is particularly noticeable on the fungi granulomas due to epithelial loss. Besides, it affects the central nervous system, particularly in salmonids, as a result of which neurological symptoms such as swimming and balance disorder, swaying movement are observed in fish (Hodneland et al., 1997). The disease mainly attacks the liver. Apart from the liver, the spleen, heart, kidney, gonads, brain, gills, muscles, and nerve tissues behind the eyes are severely affected. Spinal curvature has been observed in some fish (Govind et al., 2012). The prognosis of the disease varies according to the host involved and environmental conditions (Kocan et al., 2009). There is no cure for the disease. The contaminated feed should be avoided, and factors causing stress should be eliminated (Choudhury et al., 2014).

Figure 3. Pale, necrotized, and obstructed gills caused by branchiomycosis (Khalid Subhi, 2011; Riad et al., 2015).

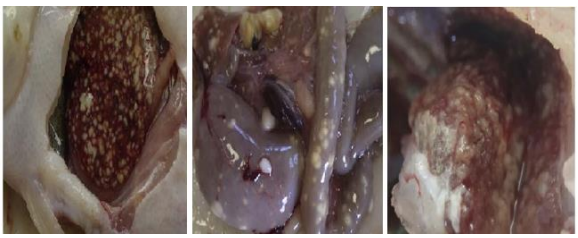

Figure 4. Granulomas formed in the liver and intestine as a result of Ichtyosporidis (Huntsberger et al., 2017).

6. Conclusion

Fungal infections represent an essential part of fish diseases. There is a considerable amount of literature on fungal diseases in fish controlling fungal diseases is necessary to ensure continued growth in the aquaculture industry. It is important to continue studying the underlying molecular processes of fungal – host fish interactions.

Author Contributions

All authors had equal contribution and all authors reviewed and approved the manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

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