

SOME APPLIED PROGRAMS FOR LIVESTOCK DEVELOPMENT UNDER DESERT CONDITIONS OF EGYPT

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SUMMARY

Global demand for foods of animal origin is growing and it is apparent that the livestock sector will need to expand. The detrimental effects of extreme weather adversely affect livestock. Climatic extremes and seasonal fluctuations in herbage quantity and quality will affect the well-being of livestock, and will lead to a decline in production and reproduction efficiency.

The overpopulation and the high rate of people density in Nile valley and Delta is a major challenge. Therefore, the Egyptian Government has boosted the agricultural sector during the last seven years by constructing many projects in desert areas of Egypt. According to Egypt vision (2030), we have to exploit the available natural resources under the desert and harsh environmental conditions and to make the livestock production a real sustainable development tool for the Bedouins.

Research Staff of Animal and Poultry production Division at the Desert Research Center are investigating their research programme to deal with the ecosystem of the desert which is suffering from a deficiency in fresh water, long draught season, a severe shortage in the conventional feedstuffs, animal diseases at the boarder governorates, etc..For example, In the field of animal breeding, a good program was started to implement the recent techniques of marker-assisted selection to improve local strains of sheep and goats productivity. In the same way, the utilization of agro- industrial by-products, desert shrubs and salt tolerant plants in animal and poultry feeding appeared to decrease the drastic gap in animal feeding under desert condition were taken into consideration. The recent molecular techniques such as next generation sequencing and classical cultivation techniques to identify camel rumen bacteria and fungi and their ability to produce lignocellulolytic enzymes were also investigated. Moreover, sustainable value chain approach for livestock by products (milk, meat, wool, fur) based on livelihood strategies for Bedouin communities for sustainable development strategies were discussed.

Keywords: *livestock, sustainable development, salinity, animal feeding, animal breeding*

INTRODUCTION

Under the Egyptian desert condition, livestock production is suffering from several obstacles i.e. shortage of feed, water scarcity, drought, salinity and many other factors that negatively affect productive and reproductive performance.

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Research Staff of Animal and Poultry production Division at the Desert Research Center are investigating their research programme to deal with the ecosystem of the desert which is suffering from a deficiency in fresh water, long draught season, a severe shortage in the conventional feedstuffs, animal diseases at the boarder governorates, etc..In the field of animal breeding, we start to implement the new

techniques that might be used in animal breeding for Barki sheep as one of the important local breeds (Ibrahim, 2021a and 2021b). In addition, one of these techniques is the identification of genetic markers that used in marker-assisted selection. In the same way, the utilization of agro- industrial by-products, desert shrubs and salt tolerant plants in animal and poultry feeding appeared to decrease the drastic gap in animal feeding under desert conditions (Abo Bakr *et al.* (2020), Kewan *et al.* (2021) and Kewan *et al.* (2019). the recent molecular techniques such as next generation sequencing and classical cultivation techniques to identify camel rumen bacteria and fungi and their ability to produce lignocellulolytic enzymes were also investigated (Rabee *et al.*, 2019; Rabee *et al.*, 2020a and b). Sustainable value chain approach for livestock by- products (milk, meat, wool, fur) -based livelihood strategies for Bedouin communities for sustainable development strategies were also investigated (El-Essawy, *et al.*, 2019, Zaki and Hassan, 2019 and Gad-Allah *et al.*, 2020). A success programme to improve animal health to accommodate climate changes and harsh conditions were conducted. For example, using natural products to combat some pathogenic bacteria (Moustafa *et al.*,

2017), preparation of veterinary vaccines and using modern techniques in isolating bacteria and diagnosing diseases (Fathy *et al.*, 2021).

In the following points, we will throw some lights on some practical and applied programmes for livestock production under desert conditions. Some of practical solutions to mitigate with the major constraints prevailing there will be discussed.

Biotechnology and animal breeding:

Since 10 years, the researchers in Desert Research Center have started to implement the new techniques

that might be used in animal breeding. One of these techniques is the identification of genetic markers related to economically important traits using candidate gene approach. In this context, the researchers identified many genetic markers that could be used to improve growth rate, milk components and reproductive performance in Egyptian Barki sheep (Table 1).

Table 1. Productive and reproductive traits affected by genetic markers

Gene	Mutations	Change	Traits affected	References
Growth traits				
BMP4	rs416697440	(T/G)	Marketing weight, Body mass index	Ibrahim, 2019
LEPR	rs1088717377	(G/A)	Post-weaning daily gain	Ibrahim, 2021b
	rs595831153	(C/G)	Marketing weight	
Milk traits				
STAT5A	rs161082816	(G/A)	Milk lactose %	Abousoliman <i>et al.</i> , 2020
GHRHR	rs414991449	(T/C)	Total Solids %	Abousoliman <i>et al.</i> , 2020
TLR4	rs592076818	(G/T)	Milk fat %; Milk protein %	Sallam, 2021
Reproductive traits				
BMP2	rs1091779032	(T/A)	Total number of lambs weaned per ewe Total weight of lambs weaned per ewe	Ibrahim, 2021a
GDF9	rs605683468	(G/A)	Twining rate	Ibrahim, 2021a
	rs410123449	(C/T)	Total number of lambs born per ewe	

Recently, we have started to use the newest tool in molecular genetics (Genome wide association analysis; GWAS) to improve economically important traits in local breeds of goats. This tool will allow identifying all mutations that affect all the desired traits in goats at the same time, which could make a faster genetic progress and then a quantum jump in production.

However, if we succeeded to identify more genetic marker associated with economically important traits of livestock, we could make a plan to implement the markers assisted selection that will make a type to improve animal productivity and hence improve the livelihood of Bedouins and small farmers.

Ecology of desert animals and biodiversity:

It is important to study the ecology of desert animals especially that climate change and desertification is rapidly transforming environments and poses a major threat to species and ecosystems worldwide. Understanding how animal populations respond to these changing environments is crucial for developing conservation and mitigation strategies. The knowledge from researches were done in desert ecology unit to understand different types of some desert animals facing the changing in climate and the desertification of its local habitat like , foxes (Mohallal, 2018), rodents (Mohalla 2007; 2013; Mohalla and Younes, 2015; Alsarraf *et al.* 2016,

2017) snakes(Kadry *et al.* 2015; Nasser *et al.* 2018) and birds (Soliman *et al.* 2020). Which arise from the sustainable use of biodiversity should be shared among all people.Environmental and taxonomic studies are among the most important problems facing decision-makers, especially with international conventions to preserve biological diversity, especially for wild animals, which necessitates a periodic inventory of different animals and re-classification processes using traditional and modern methods. Therefore, an inventory was made of the various vertebrates of the Egyptian desert in the North Sinai regions. Mount Elba, Siwa, New Valley Governorate, and nature reserves in South Sinai (Mohallal and Ahmed, 2018;Soliman and Mohallal 2016; Soliman and Mohallal, 2014).

Recent measurements for animal adaptation under desert conditions:

Under thermal stress, a number of physiological and behavioral responses vary in intensity and duration in relation to the genetic make-up of the animal and environmental factors through the integration of many organs and systems, viz., behavioral, endocrine, cardio-respiratory and immune system (Altan *et al.*, 2003). Body temperature is regulated by cytokines, which are defined as regulatory proteins or polypeptides that are produced by immune cells in response to tissue injury, infection, stress, or inflammation (Younis, 2005;

Younis and Abou El-Ezz, 2010). IL-1 β is a potent pro-inflammatory cytokine that acts as an endogenous pyrogen. It has been detected in CNS after injury to the brain or peripheral immune activation. IL-1 β acts to suppress thyroid function by inhibiting iodide uptake and leading to decrease in the plasma levels of thyroxine (T₄) and triiodothyronine (T₃) that are known to play important roles in adjustment of mammals to environmental changes (Yousef and Johnson, 1975; Younis & Abou El-Ezz, 2010). IL-6 acts as the principal regulator of the acute-phase protein response and stimulates the hypothalamic-pituitary-adrenal axis (HPA) and hypothalamic-pituitary-thyroid axis (HPT) that are known to play an important role in adjustment of mammals to environmental changes (Younis, 2005). Indigenous breeds, particularly in tropical environment are considered to have some levels of resistance to high ambient temperature (Srikandakumar *et al.*, 2003; Soleimani *et al.*, 2011). It is known that some local breeds have more heat tolerance compared to other breeds. Identification and exploitation of genotypes having thermo-tolerance in small ruminants are a major concern in the changing climate scenario, which can have a great impact on livestock productivity. Therefore, the aim of the current study was to investigate the expression pattern of heat shock protein HSP70, and HSP90 genes in Barki and Abu Dlik sheep. The results of the current study revealed that HSP70 and HSP90 family genes were expressed in sheep both constitutively. Upon local breeds, the expression of the genes studied was significantly higher in Abu Dlik as compared to Barki sheep. The most significant finding of this study was the increased HSP90 expression in both herds. This suggests that HSP70 and HSP 90 may be used as an indicator for assessing stress especially the thermal stress response of the animal. However, further more studies are warranted to validate the other genes and to qualify HSP as an indicator of stress associated response of animals under field conditions. Gene expression pattern of HSP 70 and HSP 90 can be used as a reference point in breeding to identify, manipulation and crossbreeding for the improvement of genetic potential and adaptability in sheep, and farm animals. The selection of thermo-resistant animals is an effective way to improve the productivity of cattle during high environmental temperatures, especially with potential climate changes. Further research is required to verify our results and to determine the molecular mechanism to manage stress and adaptability at a cellular level.

In the field of poultry, heat shock has been developed to increase thermo-tolerance which led to minimize heat-related mortality and to maintain of the productivity of poultry (De Basilio *et al.*, 2001). Poultry can acclimatize by exposure to repeated, short and daily heat shock (Narongsak, 2004), especially, if this exposure was applied at early

growth phases (Yahav *et al.*, 2004). Therefore, it is possible to improve survivability, growth and feed efficiency of heat-stressed chickens by prior heat exposure through controlling thermal stressors (Yalcin *et al.*, 2001).

Many heat shock programs were applied to enhance performance of poultry under heat stress, from this, early heat shock at 3-5 days of age for 4 hours at 38 or 43 °C in broilers (Rahimi, 2005) and at 3 days of age for 24 h at 37-38 °C in ducks (Nagwa *et al.*, 2012). Emam (2013) and Morsy (2018) in laying hens and Morsy (2013) in cocks. These programs improved bird's final productive performance and survival ability during exposure to heat stress at later ages.

Practical and recent trends in animal health under desert conditions:

Enhancing animal health is an important aspect not only for optimizing animal production but also, for achieving good human health which expressed as one health. One Health is an approach that recognizes that the health of people is closely connected to the health of animals and our shared environment. From this point, animal health department- animal and poultry production division- Desert Research Center cooperate to improve animal health and control diseases through the following topics, which have followed practical and recent trends:

Using recent diagnostic techniques of infectious diseases to rapid identify the causative agents and record them in The GenBank sequence database. As *Clostridium difficile* which is a new ruminant pathogen could be isolated and identified by direct PCR from desert ruminants. Formally, it has been a well-known enteric pathogen causing antibiotic-associated diarrhea and pseudomembranous colitis among humans. Now it is considered as animal and human pathogen and so, need new strategies to combat it in animal to prevent its transmission to human (Fathy *et al.*, 2021). In addition, Lumpy Skin Disease (LSD), which is an insect born, notifiable, transboundary eruptive viral disease could be isolated and identified from animals in new reclaimed desert areas by recent techniques. This dangerous infectious disease affects livestock in Egypt causing severe losses. The recommendations to overcome this disease could be summarized as follows; proper extensive vaccination process using a local efficient LSD virus isolates, further education of herd owners about the etiology and transmission of it and strict monitoring of animal in and out movements in the area of study including; quarantine should be employed by veterinary authorities in order to reduce its circulation (Allam, 2020). In aquaculture, Mai *et al.*, (2020a) investigated the most hazards affecting *Pangasius* fish farms which is the new fish breed reared in Egypt by bacteriological examination revealed the isolation of *Pseudomonas aeruginosa* pathogen that was biochemically confirmed using

MALDI-TOF MS and VITEK 2 compact system. The prevalence and virulence were estimated genotypically using species-specific 16S rDNA gene, *OprL* and *ToxA* virulent genes which detected pathogenic strains in the studied aquaculture, then followed by sequencing analysis and The GenBank sequence database documentations.

Not only practical and recent trends in diagnosis of infectious diseases but also how to control and prevent diseases by recent approaches such as using natural products. In aquaculture, control of some infectious diseases affecting cultured *Pangasius Spp.* by recent bio-products application (Nucleoforce™) was studied by Mai *et al.* (2020b). In addition, studying the use of thyme and thymol as immune-modulator for *Oreochromis niloticus* (Tilapia fish) challenged with *Strept.iniae* pathogen (Moustafa *et al.*, 2017). The results showed that these natural products could limit the studied infectious diseases without any harmful of residual effects of hazard component in fish in opposite of chemotherapy. Consequently, preserve human health from kidney and liver dysfunctions and other hazards of chemotherapy residues. In poultry, studying the biological effect of alpha-lipoic acid on aflatoxicosis in broiler chickens showed great benefits to overcome this toxicity (Mourad *et al.*, 2020).

For preventing brucellosis, which is zoonotic disease causing serious medical and economic crisis, therefore there are many efforts to prevent infection through vaccination. A study of evaluation of immunogenicity of DNA vaccine coding outer membrane protein 31 (OMP31) of *Brucella mellitensis* pathogen in mice was done. The obtained results document effectively of the vectored vaccine, can be considered as a promising candidate, and could be included in the development of a multi-subunit vaccine in controlling of brucellosis (Kamel *et al.*, 2017).

On the other hand, determination of the environmental pollutants is a very important topic in animal health researches. Donia *et al.* (2017) estimated the toxicity level of heavy metals of water and fish at El Salam Canal – North Sinai as they found that their concentrations were higher than permissible limits in the studying period, which introduced dangerous effects on environmental health. They recommended more measures to reduce these high levels.

Parasitological studies under desert conditions have a great data about parasites genetic maps at border areas. These parasites include Trypanosoma, Toxoplasma, Babesia, Theileria, Coccidia, Sarcocyst, Microsporidium, Giardia and Cryptosporidium. These isolates from desert animals were documented in The GenBank sequence database. The parasite *Trypanosoma evanzai* has been especially studied in domestic animals in different desert regions of Egypt (the Hala'ib Triangle, Siwa Oasis, South Sinai, the Delta, the Northwest Coast) and the study of the most important factors affecting its spread, as well as studying the genetic diversity of isolated Egyptian

strains and comparing them globally using DNA sequencing data and try to find a cure from natural sources. Studies have resulted in very large infection rates in different regions. The results also confirmed the polymorphism of the genetic forms of the isolated Egyptian strains, in contrast to the globally known strains that appeared closely related and homogeneous. These studies were published in several papers, some of which are Scopus, and others have a significant impact factor. Among its importance, it was cited in research published in reputable journals (Barghash *et al.*, 2018 and Barghash, 2021)

Practical trends to mitigate feed shortage under desert conditions:

Many approaches have been used to overcome the problem of feed shortage, utilize and enhance desert feed resource being as follows:

Expansion of the cultivation and spread of salt-tolerant plants, there are many plants can be cultivated under salinity condition and describe with drought tolerance, high yielding, high nutritive value, good quality fodders for small ruminants in Egypt (Anon, 2009), grown in areas of relatively low rainfall, high temperatures and with saline soils (Sakr *et al.*, 2014) and it can be successfully grown in the salt-affected areas. (Niazi *et al.*, 1999). These salt-tolerant plants are fodder beets, pearl millet, Sorghum and Panicum.

Improving forage (salt-tolerant plants) processing, utilization and storability. It is possible to carry out some manufacturing transactions such as Silage manufacturing supported with biological feed additives, Feed block processing, covered stack feed manufacturing and using feed additives which are used to enhance the effectiveness of nutrients, and protecting the animal against all sorts of harmful environmental stresses.

- **Using and improvement (processing and feed additives) of untraditional roughage** (trimming waste of fruits trees, citrus and Moringa), which present in desert areas (Terol *et al.*, 2008, Kewan *et al.*, 2019, Abo Bakr *et al.*, 2020 and Kewan *et al.*, 2021)
- **Utilization and improving desert industrial by-products** (date stone and olive pulp) through processing and feed additives (Abd El-Hay, 2020 and Abdou, 2017).
- **Application of biotechnology in rumen microbiology** especially in desert animals (camel, sheep and goats) though a) identification the cellulolytic bacteria to produce cellulolytic enzymes (enable to improve cellulose fermentation, using in industrial applications such as feed additives and biofuel production)b) identification the anti-nutritional-resistant bacteria in the rumen of camel to degrade the plant toxins in the rumen of camels

in order to utilize desert plants (Rabee *et al.*, 2019; Rabee *et al.*, 2020a and b).

- Added value chain of animal by-products: milk, meat, wool, skin, under desert conditions:

Practical research work was conducted to support animal by-products to be a tool for sustainable development. For example, due to climatic conditions and lack of cold storage facilities, it is virtually impossible to keep meat fresh for longer periods in the tropics. Therefore, processing of meat such drying, curing and smoking (by aromatic plants) are the only solution way to keep meat edible for long time (Shimaa *et al.*, 2014 and Zeedan *et al.*, 2014). Converting camel meat into products such as burgers and sausages increasing the acceptability to domestic consumers. Camels are good potential meat producers especially in arid regions where other meat-producing animals do not thrive. Processing of meat products does not require a high potential in sheep. In the same field, as milk production of goats, camel and sheep milk are important desert milks that have many benefits, the introduction of some modern methods in their manufacture had a role in raising its nutritional value and raising it to the level of food. Therefore, Desouky and El-Gendy (2017) produced a yoghurt product from goat's milk and using a probiotic starter with different temperatures for manufacturing and observing the effect of temperature on the quality of the product. El-Gendy and Abdeen (2020) have indicated produce and evaluate a beverage from permeate camels' milk fermented with probiotics and mixed with pomegranate syrup in different concentrations. fermented permeate camels' milk mixed with different concentrations of pomegranate syrup beverages can be recommended as a functional food product with potential health benefits and it can be marketed and consumed as healthy beverages. In addition, new systems were introduced for grading and processing wool produced from animals for use in various textile industries, especially the manufacture of kilims and handmade carpets to increase the profits of breeders (Gadallah *et al.* (2020). In addition, vegetable dyes were used to dye wool yarn because they are natural, environmentally friendly dyes. While, Helal *et al.*, (2013) were able to modify the horizontal loom to have an automatic movement (with a motor) to help people with special needs (mine victims in the Northwest Coast region) to work and produce. For Skin production: Azzam *et al.*, (2005) and Nasr *et al.*, (2013) used new methods for preserving and storing animal skins resulting from animal slaughter. Nasr *et al.*, (2017) uses environmentally friendly technology such as organic waste, pomegranate peel, and plants such as capracho and mimosa, which are vegetable tanning methods characterized by preserving the environment compared to other tanning methods using chrome in leather tanning to eliminate sources of pollution, which will achieve an increase in productivity and

support the competitiveness of Egyptian leather products.

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بعض البرامج التطبيقية لتنمية الثروة الحيوانية في ظل ظروف الصحراء في مصر

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يتزايد الطلب العالمي على الأغذية ذات الأصل الحيواني ومن الواضح أن قطاع الثروة الحيوانية سوف يحتاج إلى التوسع. الآثار الضارة للطقس المتقلب تؤثر سلبًا على الثروة الحيوانية. ستؤثر الظروف المناخية المتقلبة والتقلبات الموسمية في كمية ونوعية المراعي على رفاهية الثروة الحيوانية ، وستؤدي إلى انخفاض في كفاءة الإنتاج والتكاثر.

يمثل ارتفاع معدل الكثافة السكانية في وادي النيل والدلتا تحديًا كبيرًا. لذلك ، عززت الحكومة المصرية القطاع الزراعي خلال السنوات السبع الماضية من خلال إنشاء العديد من المشاريع في المناطق الصحراوية في مصر. وفقًا لرؤية مصر (٢٠٣٠) ، علينا استغلال الموارد الطبيعية المتاحة في ظل الصحراء والظروف البيئية القاسية ، وجعل الإنتاج الحيواني أداة حقيقية للتنمية المستدامة للبدو.

يقوم الفريق البحثي بشعبة الإنتاج الحيواني والدواجن بمركز بحوث الصحراء بعمل برامج للتعامل مع النظام البيئي للصحراء التي تعاني من نقص في المياه العذبة، ونقص حاد في الأعلاف ، وأمراض الحيوان في المحافظات الحدودية . على سبيل المثال ، في مجال تربية الحيوانات ، تم البدء في برنامج جيد لتنفيذ التقنيات الحديثة للانتقاء لتحسين إنتاجية السلالات المحلية من الأغنام والماعز. وبنفس الطريقة ، يبدو أن استخدام المنتجات الثانوية الصناعية الزراعية والشجيرات الصحراوية والنباتات التي تتحمل الملح في تغذية الحيوانات والدواجن أدى إلى تقليل الفجوة الهائلة في تغذية الحيوانات في ظل ظروف الصحراء. كما تم دراسة التقنيات الجزيئية الحديثة للتعرف على بكتيريا وفطريات كرش الإبل وقدرتها على إنتاج الإنزيمات. علاوة على ذلك ، تمت مناقشة نهج سلسلة القيمة المستدامة للثروة الحيوانية حسب المنتجات (الحليب واللحوم والصوف) على أساس إستراتيجيات سُبل العيش للمجتمعات البدوية من أجل استراتيجيات التنمية المستدامة.