CAMEL, THE ANIMAL OF FOOD SECURITY AND CLIMATE CHANGE

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ABSTRACT

Most camels in the world are located in East African countries, where the arid climate limits livestock alternatives, but camels, which can survive a week without water, are one of the most drought-resistant species. Consequently, pastoralists around the world, particularly in Africa, are shifting from cattle to camel and small ruminant production. In a changing climate scenario, camel, in particular, has a lot of promise for protecting poor and marginal farmers' socioeconomic standing as an alternative source of income. Despite its advantages over other domestic animals, the camel has received little attention, with the majority of attention being focused on cattle, sheep, and goats, among other things.

Egypt has a significant deficit in red meat production and, is around 55% self-sufficient (543,000 tons), which is met by importing from abroad, primarily beef, up to 99% of all red meat imports, with a total of 21.5 billion pounds, posing a significant burden on the balance of payments. In this review, the activities of the National Campaign for the Promotion of Camel Productivity under the intensive production system to reduce the gap and enhance local red meat production are being explained, considering the harsh conditions brought on by climate change, drought, water scarcity, and environmental implications. In addition, the common camel diseases and rumen microbial populations and its classification are taking place in the review.

Keywords: Camel, food security, climate change, rumen microflora, diseases

INTRODUCTION

Climate change has been occurring at an alarming rate over the last few decades and has begun to have an influence on human and natural ecosystems (IPCC, 2014). Globally, climate change represents an environmental, social and economic challenge. Egypt, on the other hand, produced about 0.6% of the world's total of 49.3 billion tons of carbon dioxide equivalent, which contributes to greenhouse gas emissions. The emissions from agriculture and irrigation amounted to approximately 2.57 million tons of carbon (1.25% of the total emissions from all sectors, Central Agency for Public Mobilization and Statistics, CAPMAS, 2019). Enteric fermentation (40%), manure left on pasture (16%), chemical fertilizers (13%), rice farms (10%), manure management (7%) and agricultural waste burning are the major emiters in agriculture. However, livestock was responsible for approximately two-thirds of overall emissions (The food and agriculture Organization of the United Nations, FAO, 2018).

Agriculture is a major component of the Egyptian economy, contributing up to 11% of the gross domestic product, while the contribution of livestock production in the agriculture sector is about 36% (CAPMAS, 2021), which requires more efforts to develop this sector. The estimated number of livestock in Egypt is around 18.4 million heads, being greater for sheep by 30%, followed by cows (27%), goats (23%), and buffaloes (19%), while camels' number is the lowest with less than 160 thousand heads, representing almost 0.85% of the total livestock number (CAPMAS, 2018). Almost, 82.4% of that number is slaughtered annually, covering 4.04% of the meat consumption in Egypt (FAOSTATE, 2019). However, in comparison with sheep, cows, goats and buffaloes, only camels are represented by greater numbers (>51%) in the desert governorates than those in the other governorates, being greater for the Red Sea Governorate by 36.5% of the estimated number of camels in Egypt.

On the other hand, Egypt has a significant deficit of red meat production and is presently around 55% self-sufficient, which is about 543,000 tons, while the available red meat for consumption is around 988,000 tons (CAPMAS, 2021). The red meat shortfall is estimated to be over 445,000 tons, which is met by importing from abroad, primarily beef (cows, 444,399 tons), which accounts for up to 99% of all red meat imports with a total of 21.5 billion pounds, posing a significant burden on the balance of payments. To reduce the gap and enhance local red meat production, cost-effective strategies must be developed, considering the harsh conditions brought by climate change, drought, water scarcity and environmental implications.

The importance of camels, in view of the climatic change, in achieving food and economic security as well as contributing to filling the meat production shortage, is appeared. The great importance of camels to the food supply is coming in large part because of their ability to utilize fibrous materials not of immediate nutritional value to people, particularly in the desert area in which grazed forages provide the greatest amount and least expensive source of energy for camel's production systems. Due to their physiological and morphological characteristics, camels possess excellent adaptive properties for deserts, are well adapted to arid environments, desertification and scare natural resources, and considered a major source of livelihood for people living in the arid and semi-arid areas (Askar, 2019), contributing in the sustainable development of desert regions and considered the most productive livestock species for milk and meat under these harsh conditions (Askar, 2021a and b).

Most camels in the world are located in the East African countries in which the arid climate of the region limits options for raising other livestock species but camels, which can go up to a week without water, have the advantage of being one of the most drought-resilient species. Consequently, pastoralists around the world, particularly in Africa, are shifting their production from cattle to camel and small ruminant production. In a changing climate scenario, camel, in particular, has a lot of promise for protecting poor and marginal farmers' socioeconomic standing as an alternative source of income. Despite its advantages over other domestic animals, the camel has received little attention, with the majority of attention being focused on cattle, sheep, and goats, among other things.

The ability of camelids, particularly of the dromedary, to adapt to the extreme aridity of habitat is unique amongst large herbivores. The most significant aspect of this adaptation is the economic use of water in almost all metabolic functions. These metabolic functions fall into two major categories, intermediary metabolism and the maintenance of body temperature, in the usual habitat of the dromedary this generally means cooling. The usual habitat of the camel is not only characterized by the high temperatures and scarcity of water but a consequence of these environmental conditions also by a considerable seasonal variation in availability forage quality and forage quality. Herbivores can adapt to such fluctuations in forage quality by either increased selectivity for high quality plant materials or by more efficient digestion of poor quality one. The camel can do both (Schwartz and Dioli, 1992).

1- The National Campaign for the Promotion of Camel Productivity in Egypt, NCPCP:

1-1- The Intensive Production System, Investment Projects, and Environmental Implications:

Recently, under the semi-intensive production system, our team of the National Campaign for the Promotion of Camel Productivity, NCPCP (2017-2020, 1st stage) has applied the early weaning technique in camels, employing the creep feeding on a small scale. However, the preliminary results were promising with a production of 300 kg body weight camel-calves (average daily gain = 780 g/ day) within only one year of age. High economic efficiency of feed utilization was obtained (feed conversion = 5.0-5.5 kg feed/ kg live body weight) with a lower daily feed intake (1.5-2.0% of body weight) and cheaper diet (high roughage to concentrate ratio) in comparison with producing cow-calves (Askar et al., 2021b). A considerable comparative advantage in terms of growth with young camels is reported (NCPCP, 2017-2020, 1st stage). Furthermore, our result also demonstrated that increasing the concentrate supplement level in ration has no much influence on average daily gain and digestibility, therefore, a better feed conversion ratio was obtained for low vs. high concentrate diets (NCPCP, 2017-2021, 1st stage, and Askar, 2019 and 2021a and b). Findings are coinciding with a low metabolizable energy used for maintenance (MEm) reported for camels (Filali and Guerouali, 1994 and Farid, 1995) that are less than the recommended allowance for other domestic animals, goats, sheep, cattle and buffaloes. Furthermore, in support of these findings, MacFarlane (1968) reported a low metabolic rate of camels that was 209 kJ/ kg $BW^{0.75}$ compared with 377 kJ/ kg $BW^{0.75}$ for cattle, that was recently confirmed by Dittmann et al. (2014).

On the other hand, with the advent of global warming, the quantification and abatement of methane emissions from domestic ruminants have received major attention during the last decades. It is a greenhouse gas (GHG) that also represents a loss of energy to the host animal. On a global basis, it has been estimated that livestock production contributes between 9-11% of total anthropogenic GHGs emissions with approximately 44% of livestock emissions in the form of CH_4. Dittmann et al. (2014) reported that the camelids produced less methane (0.32 L/ kg body mass/ day) when compared to literature data on domestic ruminants fed on roughage diets (0.58 L/ kg body mass/ day). They also observed that there was no significant difference between the two suborders when methane emission was expressed on the basis of digestible neutral detergent fiber intake. The lower methane output of camelids can be attributed to their typically lower relative feed intake (Askar et al., 2021b and Askar et al., 2023), which suggests that the processes/ pathways of methanogenesis through the microbial digestion of fiber in the rumen are similar amongst the species. Recently, Guerouali and Laabouri (2018) reported a huge difference in methane emission in camel compared to cattle in which they did comparison between Holstein cows and camels at a similar body weight and receiving the same ration. They showed clearly that cattle produced three times more methane than camel when the two species received the same diet (15.2 vs. 42.2 L/ kg dry matter intake, respectively). The authors attributed this difference to some important differences in digestive physiology and anatomy between cattle and camels. It is probable that in cattle the whole feeding ration was fermented in the fore-stomach, while in camel a small part of the feeding ration was fermented in the fore-stomach and the rest of the ration escaped the fore-stomach to be digested in the intestine (Guerouali and Laabouri, 2018). It has been reported that camels have increased rumen liquid phase turnover, allowing a considerable portion of the feed to escape fermentation and be digested in the intestine (Heller et al.,1986), resulting in less methane production. A comparable bacteria population of the fore-stomach were reported for cattle and camels (Askar et al., 2023) with less protozoa found in camels (Kayouli et al., 1993), suggesting a less methane production in camels because methanogenic bacteria are living in symbiosis with protozoa. A limited production of acetate to propionate ratio in camels compared to cattle fed the same ration (Rouissi, 1994) may in some way explain the reduced methane production in camels. Although, camels spend less time in rumination and mastication in compared to cattle, they produce more saliva (Kay and Maloiy, 1989) that is also not in favor for methane production. According to the findings reported by Jouany (2000), camels have a huge buffering capacity with ruminal pH never falling below 6 and do not exhibit metabolic disorders such acidosis, which is common in cattle fed high concentrate diets. Hence considerable research efforts are needed to promote development of this neglected species in the changing climate scenario.

Furthermore, the capital investment required for the camel-calves project is predicted to be significantly less than that required for cow-calves of the same flock size (Hussein et al., 2021 and 2022). In addition to a lower purchase price for camel-calves, fattening/ growing projects can be implemented in arid or desert regions without additional or special preparation against heat stress, drought, or water scarcity (Askar et al., 2021a). Employing proper feeding programs with camel-calves will improve the growth rate and ensure the production of heavy, high-quality, and flavored carcass to the market at a valuable price and at young age (Askar et al., 2021b). If this approach managed properly, camel-calves can be slaughtered throughout the year, resulting in an effective contribution to Egypt's meat self-sufficiency and enhancing a cleaner environment with significant lower pollution (NCPCP, 2020-2023, 2nd stage). This is considered a valuable source of income that will encourage breeders to include camels in their animal production projects that considers an important step for the sustainable development of camel productivity in Egypt.

It has been concluded that camels are the best cost-effective choice for producing red meat (Hussein et al., 2021). The lower GHGs emissions together with higher buffering capacity and greater ruminal pH are other advantages to the cost-effective production of camel-calves. Future research linking rumen microbiota, functional genes, metabolic pathway, rumen metabolites and methane emission to animal performance is highly recommended. In addition, this review will give a better understanding of the practical concept of camel investment projects that would be of primary benefit to the development of the camel industry in which improving the economic returns and food security in Egypt.

2- Rumen Microbial Populations and Digestion

The digestion in the rumen of camel, like other ruminant animals, relies on microbial fermentation that is performed through a complex network of microbial groups, including bacteria, protozoa, archaea and fungi (Rabee et al., 2020). The camel rumen microbiota received less attention compared to other domesticated ruminants and was studied using total rRNA sequencing, PCR-amplicon sequencing and clone libraries (Samsudin et al., 2011 and Rabee et al., 2019 and 2020). Rabee et al., (2020) used total rRNA sequencing to study the metabolically active microbiota under different feeding systems and reported that the active microbial community was dominated by bacteria (88-90%), followed by protozoa (6-8%), archaea (2-3%) and fungi (1%); furthermore, the bacterial community was dominated by phyla Firmicutes, Bacteroidetes, which is similar to other ruminant animals. Deep analysis of the camel rumen microbiome on the genus level indicated that camel rumen is enriched with more lignocellulolytic microorganisms (Samsudin et al., 2011 and Rabee et al., 2020). This conclusion was confirmed by Gharechahi and Salekdeh (2018) who studied the metabolic pathways in the camel rumen using shotgun metagenomic sequencing and concluded that camel microbiome is more enriched with genes related to lignocellulose degradation than cattle. Analysis of bacterial community on the family and genus level showed that camel rumen has a higher relative abundance of cellulolytic or potential cellulolytic bacteria such as Butyriovibrio, Ruminococcaceae, Fibrobacter, Treponema, and RC9_gut_group (Rabee et al., 2020). Rabee et al. (2022) compared the fiber-colonizing bacteria in the rumen of camel and sheep and found that the camel group showed a higher relative abundance of Ruminococcus, Saccharofermentans and Butyrivibrio and the sheep group showed a higher relative abundance of RC9_gut_group. The camel rumen protozoal community was dominated by the genus Diplodinium, Ophryoscolex and Entodinium; also some species in the genus Diplodinium such as *Diplodinium cameli* was observed exclusively in the camel rumen; this genus has cellulolytic activities (Kubesy and Dehority, 2002). Camel rumen fungal community was studied using RNA sequencing and clone library combined with classical cultivation techniques (Rabee et al., 2019 and 2020) and results showed that rumen fungi in camel rumen were affiliated to several genus such as Neocallimastix, Piromyces, Cyllamyces, Buwchfawromyces, and Anaeromyces; these fungi have high cellulolytic and xylanolytic activities (Rabee et al., 2019). The previous findings could explain the higher efficiency of camel in the digestion of high-fiber diets.

On the other hand, diet type is the main determiner of rumen microbiota (Henderson et al., 2015). Few studies focused on the effect of diet type on the rumen microbiota in camels. Hinsu et al. (2021) studied the effect of forage source, *Pennisetum glaucum*, *Sorghum bicolor* and *Zea mays* on camel rumen bacteria and carbohydrate-active enzymes and summarized that forage type affected the relative abundance of several bacterial groups such as Fibrobacterota, Planctomycetota, Rifebacteria, Spirochaetota, Synergistota and Verrucomicrobiota. Rabee (2022) studied the effect of Egyptian clover hay and barley straw on camel rumen bacteria and their fibrolytic activities and fermentation parameters and found that camels received Egyptian clover hay had higher rumen ammonia, total volatile fatty acids and relative abundance of Prevotella and Ruminococcus while those fed barley straw diet increased the Butyrivibrio, RC9_gut_group and Fibrobacteres; moreover, bacterial culture of camel fed Egyptian clover hay produced higher xylanase and the bacterial culture of camels received barley straw produced higher cellulase. Askar et al. (2023) investigated the effect of concentrates level on the rumen fermentation and bacteria and reported that increasing the concentrates supplementation increased rumen propionic acid but decreased acetic acid concentration; also, few bacterial groups were affected, for example, Prevotella was increased and RC9_gut_group and Ruminococcus were decreased by increasing the concentrates level.

3- Camel Health

Although, the extreme adaptation of camel in climatic change, different constrains affecting camel production, one of them is camel diseases as the consequences of climate change, including the spread of epidemics and infectious diseases especially incoming and cross-border emerging ones. Livestock in general, and camels in particular, encounter economic losses due to a variety of health and disease-related factors such as; parasites (ecto and endo-parasites), microbial pathogens (Brucella, Camel Pox….) cause in general reduced body weight gain, fertility disorders, abortion, respiratory signs and deterioration of animal production (Al Jassim and Veerasamy, 2015). In general, the common camel diseases were illustrated clearly in ATLAS for camel diseases (Hegazy and Fahmy, 2007).

In terms of climate change, increased droughts and global warming provide a great chance for disease-causing agents to develop. Ecto-parasites, for example, which are thought to be the primary vectors of many diseases, are increasing in number "particularly ticks" as preferred environmental circumstances for proliferation. As a result, several new camel diseases and symptoms emerged that had not previously existed (Abo El-Naga and Barghash, 2016).

The first enemy affecting camel health is blood parasites (*Trypanosoma, Theileria, Anaplasma* and *Babesia)* which have been transmitted to camel by ecto-parasite (ticks, fleas, lice, blood sucking flies and mites). They are common in camels, particularly in the Halaib-Shalateen region and along the North West Coast area (Abo El-Naga and Barghash, 2016 and El-Kattan, 2005). The most prevalent blood parasite is *Trypanosoma evanzai* which has been found in camels with high infection rates in several regions. The findings also corroborated the variability of the isolated Egyptian strains' which have differentiated from universal strains by characteristic genotyping, in contrast to the internationally known strains, as they have been closely related and homogenous. Consequently these features make the diagnosis of Egyptian strains more easily than previous so, effective control will be done (Barghash et al., 2018 and Barghash, 2021). Also, another blood parasite diseases in dromedaries are anaplasmosis and babesiosis which are caused mostly by *A. marginal*, *A. centrale*, *B. bovis* and *B. bigemina*. The spreading of *A. marginale, B. bovis*, and *B. bigemina* infection in camels might be due to animal movement between Egyptian governorates (Abo El-Naga and Barghash, 2016). However, the parasitic genetic maps in desert areas are well-documented by parasitological scientists in Desert Research Center, Cairo, Egypt, including *Trypanosoma, Theileria, Anaplasma, Babesia, Toxoplasma, Coccidia, Sarcocyst, Microsporidium, Giardia and Cryptosporidium* (Barghash, 2021).

In terms of microbial pathogens and camel fertility disorders issues, brucellosis is a zoonotic disease that causes major medical and economic crises as a cause of abortion and infertility. Researches had received a lot of interest in desert regions. Using the competitive ELISA approach, Wassif et al. (2017) found a 4.3% prevalence rate of brucellosis among camels in North Sinai. To protect camels from brucellosis, considerable attempts are being made to prevent infection by immunization (vaccination). Vaccines trials were made to evaluate the immunogenicity of a DNA vaccine encoding outer membrane protein 31 (OMP31) of *Brucella mellitensis*. The results obtained demonstrate the effectiveness of the vectored vaccine. It is proposed to be included in the development of a multi-subunit vaccines for the control of brucellosis to achieve One Health concept (Kamel et al., 2017).

Moreover, as a result of climate change, recently mycoplasmosis disease in camels has appeared with fertility disorders, abortion and respiratory signs. In bacteriological studies on respiratory signs of camel, recovery rate of mycoplasmas reached 18.2% of dromedaries. Concerning the seasonal effect on the prevalence of mycoplasmas in camels, a higher prevalence rate was recorded during summer (11.4%) than winter (7.7%) probably due to the effects of climatic changes as mycoplasmas are normal inhabitant in the respiratory tract and under stress conditions as winds in early summer they may cause pneumonia alone or together with viruses and or bacteria (Mahmoud et al., 2019).

Finally, many challenges are needed to manage the husbandry and veterinary efforts to the camels. These include diagnosis, control, prevention and treatment of diseases with recent techniques and approaches of these valuable food security animals. They are essential to be addressed (Al Jassim and Veerasamy, 2015).

REFERENCES

Abo El-Naga, T.R.A. Barghash, S. M. 2016. Blood Parasites in Camels (*Camelus dromedarius*) in Northern West Coast of Egypt. J. Bacteriol Parasitol, 7: 258. doi: 10.4172/2155-9597.1000258

Al Jassim, R. and Veerasamy. 2015. Review paper: Climate change and camel production: impact and contribution. /Journal of Camelid Science, 8: 1–17

Askar, A. R. 2021a. The production of veal calves in camels in an economic framework limits environmental damage. The 18th Scientific Conference for Animal Nutrition, Hurghada, Egypt. Egyptian J. Nutrition and Feeds, 24 (2), Pp: 5.

Askar, A. R. 2021b. Investments in camels: Recent trends and future perspectives. The International Conference on Sustainable Management of Smart Livestock's Farming, Alexandria University, Alexandria, Egypt, 42.

Askar, A. R., Allam, M. A., Kewan, K. Z., Darwesh, R., Lamara, M., Sabra, E. A., Allam, S. and Rabee, A. E. 2023. Effect of concentrates level on digestibility, ruminal fermentation, and bacterial community in growing camels. Animal Biotechnology. https://doi.org/10.1080/10495398.2022.2159424

Askar, A. R., Ehdaa, Refaee and Rawia Darwesh 2021b. Effects of concentrate supplement level on camel-calves growing performance under semi-intensive production system. International Conference for Nature and Natural Resources Conservation- Towards 2030 and beyond, Pp: 87.

Askar, A. R., Kewan, Khalid Z. and Sami Abo Ragab 2021a. Effects of concentrate supplement on performance and forage utilization of camels grazing the arid-area rangelands. International Conference for Nature and Natural Resources Conservation- Towards 2030 and beyond, Pp: 85.

Askar, A.R. 2019. The Role of National Campaign in the Sustainable Development of Camels in Egypt. The 17th Scientific Conference for Animal Nutrition, Taba, Egypt. Egyptian J. Nutrition and Feeds, 22 (2): 36-37.

Barghash, S. 2021. Antitrypanosomal activity of essential oils extracted from Rosmarinus officinalis and Salvia fruticosa. European Journal of Biomedical and Pharmaceutical sciences, 8 (4): 37-45

Barghash, S., Sobhy, H. M. and Razin, E.A. 2018. Activity of human plasma proteins on trypanosomiasis. European Journal of Biomedical and Pharmaceutical sciences, 5 (5): 87-97

CAPMAS. 2018. Annual Bulletin of Statistics on Livestock, Central Agency for Public Mobilization and Statistics, Egypt.

CAPMAS. 2019. Central Agency for Public Mobilization and Statistics, Egypt.

CAPMAS. 2021. Egypt in Figures, Central Agency for Public Mobilization and Statistics, Egypt.

Dittmann, M. T., Runge, U., Lang, R. A., Moser, D., Galeffi, C., Kreuzer, M. and Clauss, M. 2014. Methane Emission by Camelids. PLoS ONE 9(4): e94363. doi:10.1371/ journal.pone.0094363

El-Kattan A. M. A. 2005. Studies on some major infectious diseases of camels in Halaib, Shalateen and Abo Ramad triangle. M. V. Sc. Thesis , Fac. Vet. Med. Cairo Univ., Egypt.

FAO. 2018. Food and Agriculture Organization of the United Nations, statistical databases.

FAOSTATE. 2019. Food and Agriculture Organization of the United Nations, statistical databases.

Farid, M.F.A. 1995. Nutrient requirements of dromedary camels: protein and energy requirements for maintenance. J. Arid Environ., 30: 207-21 8

Filali, R. Z. and Guerouali, A. 1994. Maintenance energy requirements of the one-humped camel. J. Arid Environ., 26: 9-13

Gharechahi, J. , Salekdeh, G. H. 2018. A metagenomic analysis of the camel rumen's microbiome identifies the major microbes responsible for lignocellulose degradation and fermentation. Biotechnol Biofuels 11: 216.

Guerouali, A. and Laabouri, F. 2018. The camel (Camelus dromedarius) produced three times less methane than cattle receiving the same feeding ration. Rev. Mar. Sci. Agron. Vét., 6 (3):289-293.

Hegazy, A. A. and Fahmy, Lotfia S. 2007. Atlas of camel diseases. Academy of Scientific Research and Technology, ASRT, Egypt.

Heller, R., Lechner-Doll, M., Weyreter, H. and Engelhardt, W.V. 1986. Forestomach fluid volume and retention of fluid and particles in the gastrointestinal tract of the camel (camelus dromedarius). J. Vet. Med. A., 33: 396-399.

Henderson, G., Cox, F., Ganesh, S., Jonker, A., Young, W. and Janssen, P. J. 2015. Rumen microbial community composition varies with diet and host, but a core microbiome is found across a wide geographical range. Scientific Reports, 5(1):14567 DOI 10.1038/srep14567.

Hinsu, A.T., Tulsani, N.J., Panchal, K.J. et al. 2021. Characterizing rumen microbiota and CAZyme profile of Indian dromedary camel (*Camelus dromedarius*) in response to different roughages. Sci Rep 11, 9400. https://doi.org/10.1038/s41598-021-88943-9

Hussein, Basma A., Abd ElBar, A. H. and Askar, A. R. 2022. Cost benefit analysis for camel breeding to increase animal productivity and achieve the sustainable development in Egypt. JES, 51(7): 153-190.

Hussein, Basma, A, Askar, A. R., Abd El-Bar, A. H. and El-Deeb, Soha M. 2021. Study of investment efficiency for camel production projects. International Conference for Nature and Natural Resources Conservation- Towards 2030 and beyond, Pp: 88.

IPCC. 2014. Summary for Policymakers. In: Climate Change: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32. Kagunyu A.W., W

Jouany, J. P. 2000. La digestion chez les camélidés; comparaison avec les ruminants. INRA Prod. Anim., 13: 165-176.

Kamel, Y. M., Helmy, Noha A., Hafez, Amani A. and Barghash, Safaa M. 2017. Evaluation of immunogenicity of DNA vaccine coding outer membrane protein 31 (OMP31) of Brucella Meltiness in mice. Int. J. of Adv. Res., 2277-2285.

Kay, R. N. B., Maloiy, G. M. O. 1989. Digestive secretions in camels. Options Méditerranéennes, série A Séminaires, 2: 83-87.

Kayouli, C., Jouany, J. P., Demeyer, D. I., Ali-Ali, Taoueb H. and Dardillat, C. 1993. Comparative studies on the degradation and mean retention tissue of solid and liquid phases in the forestomachs of dromedaries and sheep fed on low-quality roughages from Tunisia. Anim. Feed Sci.Technol., 40: 343-355.

Kubesy, A. A. and Dehority, B. A. 2002. Forestomach ciliate Protozoa in Egyptian dromedary camels (*Camelus dromedarius*). Zootaxa 51(1):1–12 DOI 10.11646/zootaxa.51.1.1.

MacFarlane, W.V. 1968. Comparative functions of ruminants in hot environments. In: Hafez, E.S.E. (Ed.), Adaptation of Domestic Animals, pp. 264-276. Philadelphia: Lee & Febiger.

Mahmoud, Mona A., Wassif, I. M., El-Sayed, A.A., Awad, W.S.A., Noaman, Eman A and El-kattan, A. M. (2019): Some epidemiological studies on camel mycoplasmosis in Egypt. j. Egypt.vet.med.Assoc., 79(3): 699–709.

NCPCP (2017-2020, 1st stage). The National Campaign for the Promotion of Camel Productivity, Academy of Scientific Research and Technology, ASRT, Egypt

NCPCP (2020-2023, 2nd stage). The National Campaign for the Promotion of Camel Productivity, Academy of Scientific Research and Technology, ASRT, Egypt

Rabee, A. E. 2022. Effect of barley straw and Egyptian clover hay on the rumen fermentation and structure and fibrolytic activities of rumen bacteria in dromedary camel. Vet World. 15(1):35-45. doi:10.14202/vetworld.2022.35-45

Rabee, A. E., Forster, R. J., Elekwachi, C. O., Kewan, K. Z., Sabra, E. A., Shawket, S. M., Mahrous, H. A. and Khamiss, O. A. 2019. Community structure and fibrolytic activities of anaerobic rumen fungi in dromedary camels. Journal of Basic Microbiology 49(1):1–10 DOI 10.1002/jobm.201800323

Rabee, A. E., Forster, R., Elekwachi, C., Sabra, E. and Lamara, M. 2020. Comparative analysis of the metabolically active microbial communities in the rumen of dromedary camels under different feeding systems using total rRNA sequencing. Peer J., 8:e10184.

Rabee, A. E., Sayed Alahl, A. A., Lamara, M. and Ishaq, S. L. 2022a. Fibrolytic rumen bacteria of camel and sheep and their applications in the bioconversion of barley straw to soluble sugars for biofuel production. PLoS ONE 17(1): e0262304. https://doi.org/10.1371/journal.pone.0262304.

Rouissi, H. 1994. Étude comparative de l'activité micro - bienne dans le rumen des dromadaires, des ovins et des caprins. Thèse Université de Gent, Belgique, 120 p.

Samsudin, A. A., Evans, P. N., Wright, A. D. and Al Jassim, R. 2011. Molecular diversity of the foregut bacteria community in the dromedary camel (*Camelus dromedarius*). Environmental Microbiology, 13(11): 3024–3035 DOI 10.1111/j.1462-2920.2011.02579.x.

Schwartz, H. J. and Dioli M. 1992. The one-humped camel in Eastern Africa. A pictorial guide to diseases, health care and management. Verlaine Josef Margraf, Scientific Books, FR Germany.

Wassif, I. M., Mohamed, R. H. and El-Kattan, A. M. 2017. Studies on ruminant brucellosis in El Salam canal area, Egypt. Benha Journal of Applied Sciences, 2(1):151-155.

الجمل، حيوان الأمن الغذائي وتغير المناخ

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[2] قسم صحة الحيوان والدواجن ، شعبة الانتاج الحيواني والدواجن، مركز بحوث الصحراء، القاهرة.

[3] قسم الانتاج الحيواني ،المركز القومي للبحوث، القاهرة.

الملخص العربي

تقع معظم الإبل في العالم في دول شرق إفريقيا ، حيث تتميز بسمات التغيرات المناخية وخصوصا المناخ الجاف والذي يعوق تنمية الثروة الحيوانية من الماشية، لكن على العكس في الإبل ، التي يمكن أن تعيش أسبوعًا بدون ماء ، هي من أكثر الأنواع مقاومة للجفاف والتغيرات المناخية الحادثة حاليا. ونتيجة لذلك ، يتحول الرعاة في جميع أنحاء العالم ، ولا سيما في إفريقيا ، من إنتاج الماشية إلى إنتاج الإبل والحيوانات المجترة الصغيرة. في سيناريو المناخ المتغير ، تمتلك الإبل ، على وجه الخصوص ، الكثير من الأمل في حماية المكانة الاجتماعية والاقتصادية للمزارعين الفقراء والهامشيين كمصدر بديل للدخل. وعلى الرغم من مزايا الابل مقارنة بالحيوانات المستأنسة الأخرى ، لم يحظ الجمل باهتمام كبير ، مع تركيز غالبية الاهتمام على الماشية والأغنام والماعز.

وتعاني مصر من عجز كبير في إنتاج اللحوم الحمراء ، وتبلغ نسبة الاكتفاء الذاتي في مصر حوالي 55٪ (543 ألف طن) ، والتي يتم تلبيتها عن طريق الاستيراد من الخارج ، بشكل أساسي لحوم البقر ، بنسبة تصل إلى 99٪ من إجمالي واردات اللحوم الحمراء ، بإجمالي 21.5 مليار جنيه ، مما يشكل عبئا كبيرا على ميزان المدفوعات. في هذا المقال ، يتم شرح أنشطة الحملة القومية للنهوض بإنتاجية الإبل في ظل نظام الإنتاج المكثف لتقليص الفجوة وتعزيز إنتاج اللحوم الحمراء المحلية ، مع الأخذ في الاعتبار الظروف القاسية الناجمة عن تغير المناخ والجفاف وندرة المياه ، والآثار البيئية. بالإضافة إلى ذلك ، فإن أمراض الإبل الشائعة ومجموعات ميكروبات الكرش وتصنيفها تم التطرق لها من خلال هذا المقال.

الكلمات الدالة: الإبل ، الأمن الغذائي ، تغير المناخ ، ميكروبات الكرش، الأمراض.