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Assessing the Extent of Implementation of Good Camel Feeding Practices by Camel Breeders

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ABSTRACT

Camels are integral to Saudi Arabia's culture and heritage, playing a significant role in the nation's economy. They are valued for their meat and milk, which offer high nutritional value and numerous health benefits. Additionally, camels contribute to rural development through trade and beauty contests. Globally, interest in camel products has risen due to their health properties. In response, Saudi Arabia has established the "Camel Club" to promote the sector, which is essential in achieving food security as part of Saudi Vision 2030. However, good nutrition has positive effects on both the health of the animal and its food products. There is a lack of local studies on camel breeders' feeding practices in Saudi Arabia, making this study crucial. The study aims to assess how camel breeders in Saudi Arabia follow good nutrition practices. It seeks to identify the characteristics of breeders and evaluate their feeding practices. A descriptive approach was employed, using a survey distributed to a representative sample of 442 breeders. Data were collected through a questionnaire and analyzed statistically. The results revealed that 41% of breeders rely on traditional feeding systems, primarily using barley and alfalfa, while 52.5% do not use compound feed, there remains a need for greater efforts to improve certain practices. While camel breeders are generally aware of the importance of good camel nutrition, several practices require improvement. The study recommends raising awareness about good and balanced nutrition, providing training programs on best practices in camel nutrition, and providing supportive infrastructure to help breeders improve their practices.

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KEYWORDS: Camels, good practices, feeding practices, camel breeders, Saudi Arabia.

1. INTRODUCTION

Camels play a crucial role in Saudi Arabia's culture and national identity, Men in Saudi Arabia have held on to camels, and camels have become a symbol of heritage, economic and social life, a source of pride among tribes, and a source of wealth, as the prices of beautiful camels may reach several million Saudi riyals, in addition to the keenness of many camel breeders to preserve camels as historical customs and traditions inherited from fathers and grandfathers. as they are an important resource for milk, meat, and economic development through camel trade, camel beauty contests, and the development of rural communities interested in camel breeding. Camels can adapt to the dry desert climate of Saudi Arabia. Camels have an exceptional ability to adapt, allowing them to withstand high temperatures. They conserve water by lowering their metabolic rate and regulating their body temperature. The camel heart plays a crucial role in this adaptation, as specific genes are expressed in heart tissue that are essential for environmental adaptation (Lee *et al.,* 2024).

Globally, there is a growing interest in camel milk and products due to their health and nutritional benefits and consumer acceptance (Berhe *et al.,* 2017). Camel milk is rich in nutrients, vitamins, and minerals, is lower in fat than cow's milk, and has therapeutic properties for diseases such as diabetes and cardiovascular diseases. Camel meat is also known for its rich content of protein and iron and low levels of fat and cholesterol, making it a suitable option for a healthy diet (Abrhaley *et al.,* 2017) (Swelum *et al.,* 2021). Saudi Arabia has paid great attention to camels, as a royal decree was issued to establish the "Camel Club" on July 21, 2017, and His Royal Highness Prince Mohammed bin Salman bin Abdulaziz, Crown Prince, is the general supervisor of the club.

These animals are essential to the survival and well-being of millions of families in more than 90 countries, especially local communities, and have a far-reaching impact on global food security, nutrition, and economic development, making them extremely

important on a global scale. Therefore, international organizations focus on achieving strategies and plans aimed at securing food and eliminating hunger by 2030 (World Food Summit, 1996). Livestock plays an important role in reducing poverty and increasing food security and It is necessary to build capacity in camel husbandry practices to improve the knowledge and practice of camel breeders (Marshall *et al*. 2018). Animal products (meat, milk) are an integral part of food security to protect consumers and meet their nutritional preferences and needs for a healthy life. The importance of food security in the Arab region has increased in recent years (ESCWA United Nations, 2018). In line with the adoption of the Sustainable Development Goals in late 2015, the United Nations has continued to prioritize food security as one of the most pressing issues facing humanity (Stephens *et al.*, 2018).

Global demand for animal products has increased due to population growth, improved incomes, and urbanization, and by 2050, demand will increase to 455 million tonnes of meat and 1,077 million tonnes of milk (Alexandratos and Bruinsma, 2012). Livestock production systems have evolved rapidly in recent years to meet the growing and sustainable demand for animal products. Recent trends in livestock production systems focus on the balance between the intensification of livestock systems and ensuring the livelihoods of livestock-dependent households, best practices for more sustainable camel management, animal disease control, animal genetic resources management, and feed production (FAO, 2016; Robinson *et al.*, 2011). Saudi Arabia is making great efforts to develop the agricultural sector, both plant and animal, to ensure food security. The number of sheep reached 21 million heads, goats 6.5 million heads, camels 1.5 million heads, cows 302,000 heads, and 5 million poultry and birds in non-specialized holdings (GASTAT, 2020).

Feed is an essential element in the sustainable production of animal-based foods. It is a prerequisite for food safety and human health, as well as a necessity for animal health; feed affects not only human food security and health but also the sustainability of animal production and profits, as well as improving the surrounding environment (Makkar *et al.*, 2016). Feed costs represent 65% to 70% of the operational cost of breeding. Therefore, improving the sustainability of animal products such as milk and meat is urgent and vital to reduce potential negative impacts on humans. Conversely, the lack of proper animal care or unsound practices, especially about their feed, may lead to breaking the first part of the food chain and negative consequences for food security, in addition to economic losses and health problems that affect consumer safety (Sun & Guan, 2018).

The Codex Alimentarius Commission has issued a guide to good animal feeding that sets out the basic principles of feed safety management and good animal feeding practices at any stage of the feed chain from feed producers to animal feeding by breeders (Codex, 2004). The EU countries, under the Feed Safety Requirements Regulation No. 183/2005, encourage the feed chain sectors to develop such guides of practices that ensure the protection of human, animal, and environmental health as well as feed safety and quality (Bouxin, 2014).

The failure to use safe and appropriate feed for the animal that meets the nutritional needs is due to several reasons, including the breeder's culture and education, as most breeders have low education. There are also some reasons related to the feed itself, such as being of poor quality and not meeting the animal's nutritional and production needs (MEWA, 2020).

The importance of the study lies in the great importance of camels in Saudi culture, as they are a source of health benefits through their milk and products. Therefore, the quality of their feed and its good nutrition are of great importance in the quality and safety of food and the environment. In addition, feed constitutes about 70% of the costs of raising camels (Makkar *et al.*, 2016). Therefore, the importance of this study stems from the importance of good nutrition for camels, and thus the quality and safety of camel products and reducing the pollution of their products. This study is the first of its kind in this field in Saudi Arabia. Therefore, applying sound and sustainable nutrition practices to maintain the quality of camel feed may contribute to reaching results and recommendations that contribute to raising the level of nutrition practices applied by camel breeders. This study adds an expanded information base on the importance of camel breeders' awareness and practices in Saudi Arabia regarding nutrition practices, especially in light of the scarcity of local studies conducted on camel breeders' practices and trends in this subject. Also, given the great importance that the livestock sector has enjoyed in Saudi Arabia in recent years, and its role in serving the goals of sustainable agricultural development and achieving Vision 2030.

The problem of the study is that the quality of feed is of great importance in the productive efficiency and sustainability of camels. The failure of breeders to use lower-quality feed for animals that do not meet their nutritional needs is due to several reasons, including the breeder's culture, education, knowledge, and practice regarding animal nutrition. There are also some reasons related to the feed itself, such as it being of poor quality that does not meet the nutritional and productive needs of the animal, or the use of feed mills of poor-quality feed inputs (MEWA, 2020). Given the insufficient coverage of this topic in Saudi Arabia, this study will seek to narrow this research gap by shedding light on breeders' practices in the field of camel nutrition. The main objective of the study is to analyze the extent to which camel breeders apply good camel feeding practices, explore the feeding systems followed by camel breeders, and identify some health and nutritional problems resulting from feeding practices.

2. MATERIALS AND METHOD:

Samples were done following ethical approval from the Human Ethics Committee of King Saud University (Reference No. HEC 2021/758) to conduct this study.

2.1 Research Design:

This study is based on a quantitative research methodology using a survey design, where a cross-sectional survey design was used to collect data at a specific point in time and analyze the extent to which camel breeders apply good nutrition practices, explore the beginning of camel breeders' use of compound feed, and identify the most important observations resulting from the use of compound feed.

2.2 Study Population and Sample:

The study population consisted of camel breeders in Saudi Arabia. Their information was obtained from the Ministry of Environment, Water and Agriculture (MEWA) database. As of December 31, 2021 (MEWA, 2021). An online survey was developed to collect data from January to March 2022. Electronic questionnaires were shared with all camel breeders in the database through email and Text messages. The researcher prepared a letter that included the purpose of the study and contact information for the researcher. camel breeders were given one month to fill out the electronic questionnaire, and 281 questionnaires were delivered without any reminder. A reminder was then sent to all breeders who did not respond after this period. After this reminder, two weeks were given to complete the electronic questionnaire. During this period, a further 131 questionnaires were collected. The researchers sent a final reminder to all breeders who did not respond, giving them another two weeks to complete the electronic questionnaires. In this period, 116 responses were collected. A total of 528 responses were returned to the researchers. Eighty-six questionnaires were excluded due to incomplete data. Therefore, in the final analysis, the study sample consisted of 442 breeders.

2.3 Data collection tool:

The questionnaire was used as a means of collecting data for this study. The questionnaire questions were prepared based on a review of previous studies, a review of legislation related to feeding animals, and the researcher's personal experiences. The questionnaire included four main sections: general data and personal characteristics, practices related to camel feeding, the beginning of camel breeders' use of compound feed, and identifying the most important observations resulting from the use of compound feed. Moreover, each item was examined based on its suitability for the study by five experts from the Department of Animal Production and Agricultural Extension at King Saud University. Additionally, pre-testing the tool with 15 camel breeders before data collection ensures that the content is valid. Four items were reformulated to reflect the local raising context in Saudi Arabia, according to responses from breeders who participated in the pre-test. Not all breeders participating in the pilot study were included in the sampling process. Accordingly, the camel breeders' practices scale proposed for the study reached the established standards of validity and content reliability.

2.4. data analysis:

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS, version 28.0, IBM Corp, Armonk, NY, USA.). Responses were reported using descriptive statistics methods such as frequency distributions, percentages, and arithmetic mean. Similarities and differences between the trends examined about the average adoption score were explored using hierarchical agglomerative cluster analysis. Euclidean distance was applied as a measure of divergence, and Ward's hierarchical clustering method was used for the trends of the camel breeders under study.

3. RESULTS AND DISCUSSION

3.1. Socioeconomic Characteristics of the Respondents:

The data in Figure (1) indicate the socio-economic profiles of the livestock breeders surveyed. The results reveal that more than half,70.3%, are males due to this group's demand for raising camel, which requires work related to raising animals and selling them in the markets. Therefore, they are more capable of meeting the requirements of this profession, and 29.7% are females. camel breeders were 39.11 years old on average, and 68% of camel breeders have between secondary and university education. Moreover, camel breeding was the main occupation for the % of breeders 76%. Also, 52% of Their experience ranges from (13 - 31 years) of camel-raising. Only a small proportion of breeders 12% were members of local livestock associations, in addition, 29% of camel breeders raise camels for hobby purposes and not for commercial purposes. more than half of camel breeders (51%) own camels with 1 to 20 heads. Most breeders (66%) raise camels on pastures in the desert, while about 18% use barns. to raise their camels.

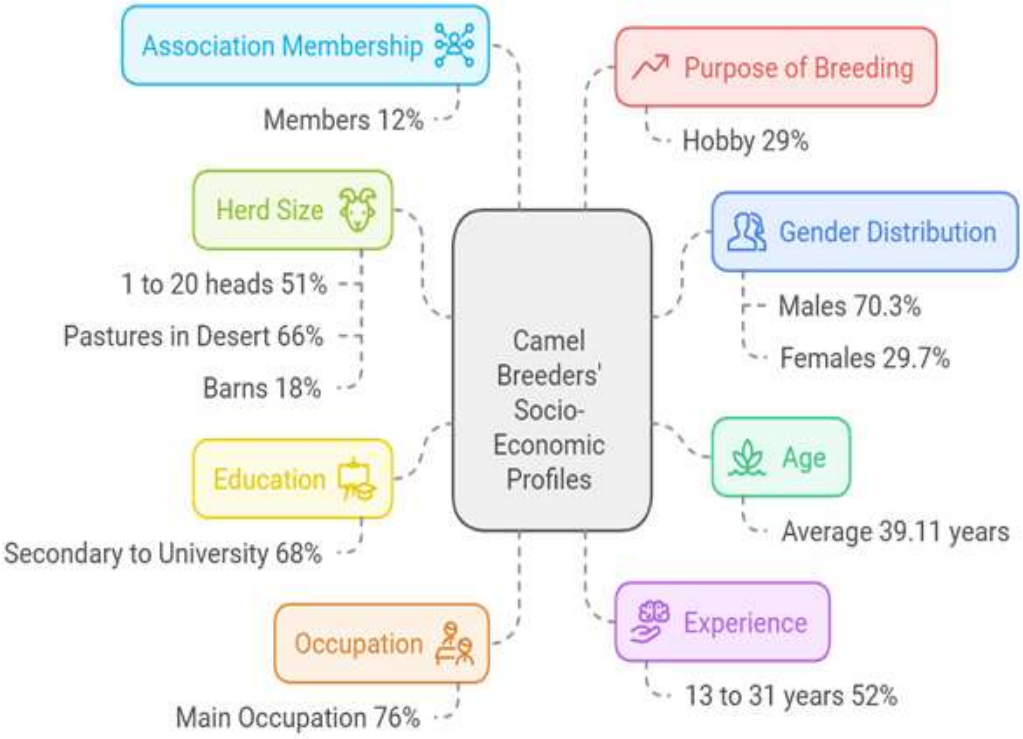

Figure (1): Distribution of camel breeders according to the Socioeconomic Characteristics of the Respondents

3.2. Feeding practices applied by breeders:

3.2.1. Feeding systems:

The data in Figure (2) 41% of breeders relied on traditional feed (barley and roughage) as the main feeding system for their camels, this is similar to what Al-Mutairi (2023) mentioned, that 32.4% of livestock breeders depend on traditional feeding (roughages and barley) as the main feeding system for their livestock, and it also consistent with what was reported by Salama *et al.*, (2019) revealed that the rate of feeding on grains in Egypt has increased directly by 78.3% of livestock breeders, which is a traditional practice in the field of nutrition. The data in Figure () indicate that more than a quarter of the breeders, 27%, follow grazing and roughage, and 22% of camel breeders follow a mixed feeding system of the compound and traditional feed, while it was found that 10% use compound feed only.

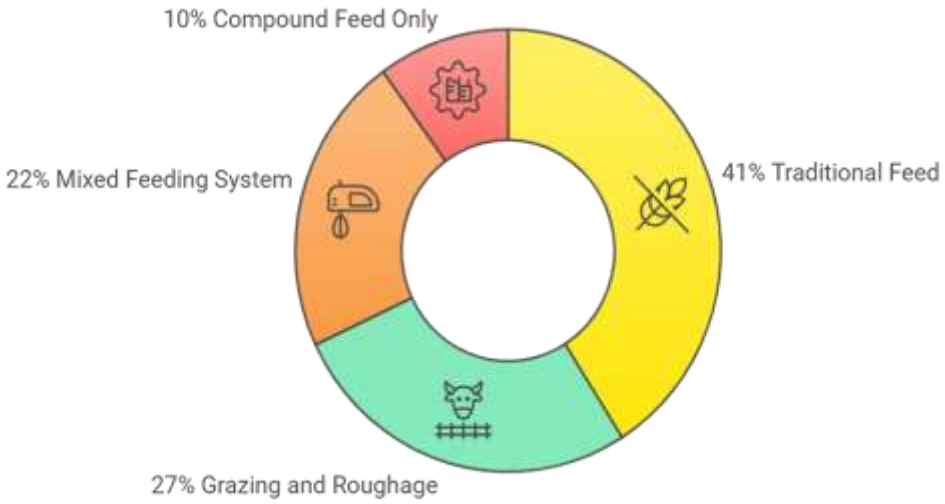

Figure (2): Distribution of camel breeders according to the According to the feeding system followed

We find that 38% of camel breeders use green alfalfa to feed camels because alfalfa is a feed crop available throughout the year, and because of its high nutritional value, especially its high protein content, and being a palatable animal feed. We also find

that 31% of camel breeders feed their camels on Rhodes grass, while 19% of the total camel breeders use alfalfa hay to feed camels. In contrast, it was found that there are varying percentages of camel breeders who use filling roughages to feed camels, represented by sorghum, bluebonnet, bonicam, and Sudan grass at rates of 6%, 4%, 1%, and 1% respectively.

Figure (3) shows that the vast majority of camel breeders, at 72%, rely on barley to feed camels, considering that barley is a good source of energy and compensates for the deficit in green fodder, especially since it was supported by the government during the past decades, and thus the demand of breeders for it to feed their livestock has become very high. This is consistent with what was stated by Salama, *et al.* (2019) about the high percentage of direct grain feeding, which was represented by 78.3% of livestock breeders, and that it is one of the traditional practices in the field of nutrition. It was also found that 8% of camel breeders use yellow corn and wheat equally to feed camels and 3.4% use soybean powder. The percentage of camel breeders who use oats to feed camels was 1%, while it was found that 11% of camel breeders do not use any grain to feed camels.

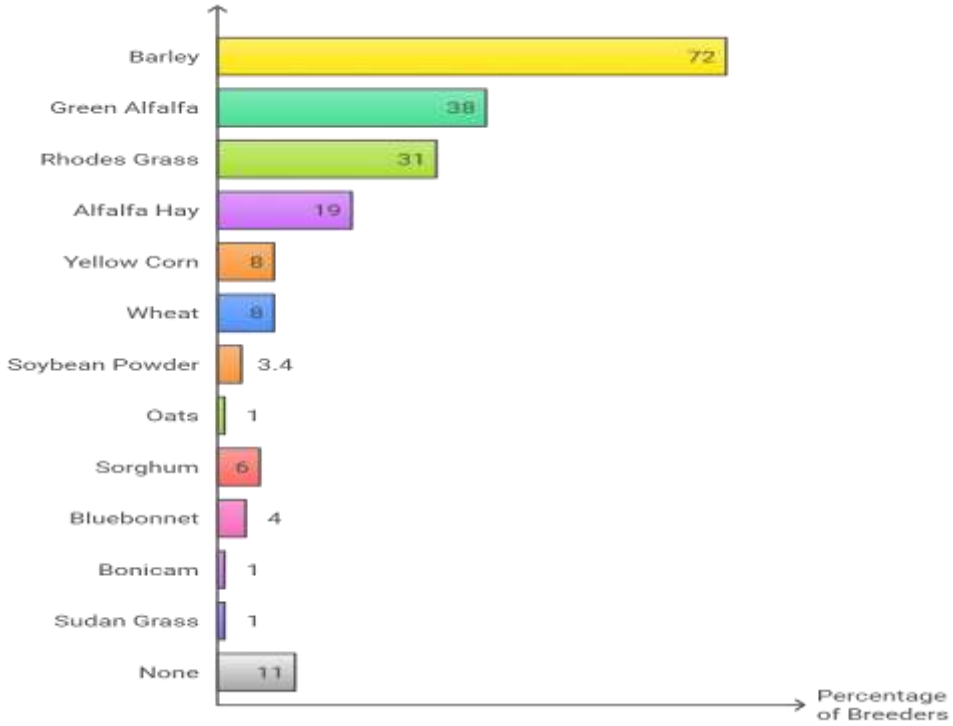

Figure (3): Distribution of camel breeders according to the Feeding practices applied by breeders

3.2.2. Feed formulation:

The data in Figure (4) indicate the distribution of camel breeders according to the practice of mixing feed camels; more than half of the breeders, 56%, do not mix feed camels, because feed additives are expensive and require special and precise mixing equipment and tools and skills that may not be available to many camel breeders. While only 44% of camel breeders mix feed camels, this result is not consistent with what Lukuyu *et al.* (2011) stated that most livestock breeders mix a range of locally available feeds to feed their livestock, and what John (2019) stated that most livestock breeders, 76%, adopt high-level feed formulation practices.

3.2.3. Use of feed additives:

The data in Figure (4) shows the distribution of camel breeders according to the use of feed additives (vitamins and minerals); it is clear that nearly two-thirds of camel breeders, 66%, do not use feed additives when mixing and formulating feed. While 34% of camel breeders use feed additives, due to their importance in combating diseases resulting from vitamin and mineral deficiencies, thus improving the production and health efficiency of camels.

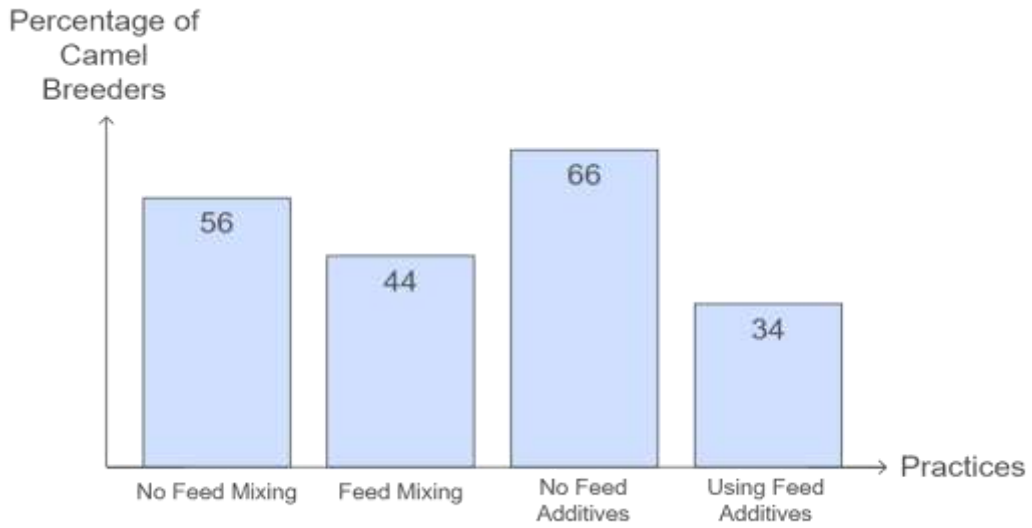

Figure (4): Distribution of camel breeders according to the mixing and use of feed additives (vitamins and minerals)

3.3. Feeding on compound feed:

3.3.1. The beginning of using compound feed:

Figure (5) shows the beginning of the use of compound feed in camel nutrition; 39% of breeders started using compound feed (1-2 years ago), followed by 34% of camel breeders who started using compound feed (more than 7 years ago). The study also showed that 15% of camel breeders started using compound feed (3-4 years ago), while we found that 11% of camel breeders started using compound feed (5-7 years ago). The results show that breeders did not spend long periods adopting compound feed, and the reason may be their lack of knowledge of the components of compound feed and its high cost compared to roughage feed.

3.3.2. Continued use of compound feed:

Regarding the desire to continue using compound feed in the future, Figure (5) shows that 44% of camel breeders want to continue using compound feed, despite noting some health problems resulting from the use of compound feed in feeding, breeders prefer to use it in feeding their camels due to the high prices of traditional feeds and their scarcity, such as barley and alfalfa, as a result of the decision to lift government support for many feed inputs and also the decision to stop growing green roughage in Saudi Arabia. This is consistent with what John (2019) stated about the desire of most livestock breeders in Uganda to practice and use compound feed by 70%, while we find that 56% of the total camel breeders do not want to continue using compound feed. The reason may be due to the emergence of some health problems in camels due to using these feeds or their lack of knowledge of the components of compound feed.

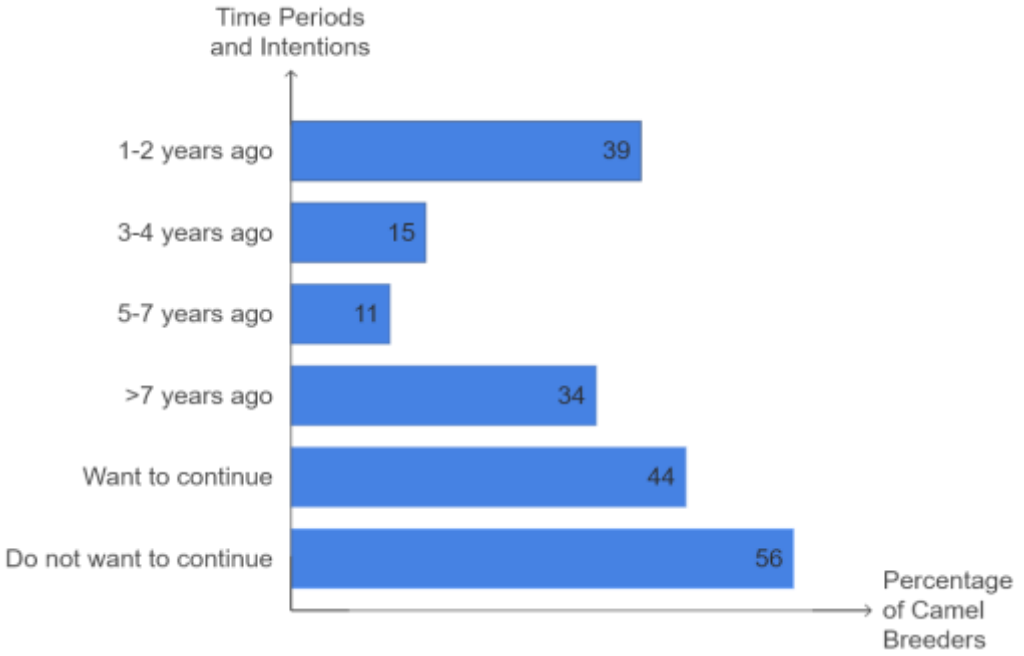

Figure (5): Distribution of camel breeders' duration of use of compound feed and desire to continue using

3.3.3. Health problems from using compound feed:

According to graph (6), the majority of camel breeders (59%) do not notice any health or other problems in camels when using compound feed, which is consistent with Blanco *et al.* (2015) who reported that compound feed does not cause health problems in animals when used to fatten young lambs in the UK. It is also evident that 41% of camel breeders notice health problems in camels when using compound feed to feed their camels.

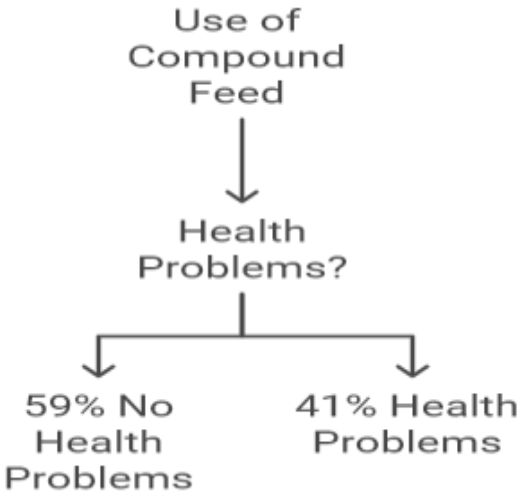

Figure (6): Distribution of camel breeders according to health problems observed when using compound feed

Regarding the type of health problems observed when using compound feed, the data in Table (1) indicate that 16% of camel breeders noticed a change in the color of the meat and the appearance of tumors (abscesses) equally, while 11% of camel breeders noticed that their camels had diarrhea, while 9% of camel breeders noticed that their camels had various diseases and problems with milk production equally, This is consistent with what Al-Mutairi (2024) found that 73% of livestock breeders noticed a change in the color of meat, while 53.8% of livestock breeders noticed the appearance of abscesses on their livestock when using compound feed, and 47.4% of breeders noticed that their livestock suffer from diarrhea, while he found that 43.6% of livestock breeders noticed that their livestock suffer from various diseases. which is not consistent with what Zhong *et al.*, (2020) stated that feeding dairy cows with compound feed in China led to an improvement in the quality of milk in terms of increasing the percentage of milk protein and volatile compounds with good flavor in the milk and decreasing the percentage of milk fat, and compound feed did not affect milk production. The reason for the emergence of these health problems may be due to not adding Roughages feed in addition to compound feed, as compound feed may increase the incidence of rumen acidity, which will negatively affect the health and productivity of ruminants, and can cause dark color of animal tissues.

It is also clear from the data in Table (1) that 8% noticed that the camels had miscarriages, and camel breeders' observations about reproductive problems, hair loss, and emaciation were 6%, 4%, and 3% respectively. From the above, it is clear that there are several health problems resulting from feeding with compound feed, and they may be due to the breeders' lack of awareness of using feed according to the animal's age and production status, and this requires further scientific studies.

Table (1): Distribution of camel breeders according to health problems variable from the use of compound feed

Health Problems*	Frequency	Percentage (%)
Meat color	26	16
Abscesses	26	16
Diarrhea	17	11
Infection of diseases	14	9
Milk production	14	9
Hair pulling/loss	6	4
Wasting	4	3
Reproductive problems	9	6
Abortion	13	8
No health problems noted	30	18
Total	159	100

4. CONCLUSION

In light of the results revealed by the study, it is necessary to enhance camel feeding practices in Saudi Arabia, by raising awareness among breeders of the importance of feeding camels with integrated rations that meet the nutritional needs of the animal according to the age and productive status of the animal; as the majority of camel breeders do not use any concentrates or compound feed in feeding camels, and to enhance the role of animal extension through methods and extension programs to increase the knowledge and skills of breeders to encourage them to apply modern management practices in animal production through proper methods of feeding and caring for camels to make the camel sector a more sustainable profession, as most breeders use a traditional feeding system that does not achieve productive efficiency for camels.

It is also important to conduct more studies on the effect of compound feed on the change in meat color. The appearance of tumors on camels when used, and to clarify the extent to which feeding with compound feed is related to them, as these were the most common health problems observed among breeders who use compound feed in feeding. Raising awareness among breeders about the importance of mixing feed as one of the most important good feeding practices during the use and mixing processes, as more than half of breeders (56%) do not mix feed when feeding camels, and 66% do not use feed additives such as vitamins and minerals.

Ethical Approval: The study was conducted in accordance with the approval of the Standing Committee for Scientific Research Ethics at King Saud University (Reference No. HEC 2021/758).

Funding: This research was funded and supported by the researcher.

Data Availability Statement: All data sets collected and analyzed during the current study are available from the corresponding author on fair request.

Disclaimer: The views expressed in this paper are those of the author(s) and do not necessarily reflect those of the SFDA or its stakeholders. Guaranteeing the accuracy and validity of the data is a sole responsibility of the research team.

Conflicts of Interest: The author declares no conflict of interest.

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