



Original article

Diagnosis of Actors and Relational Flows of Camel Meat Value Chain in the Western South of Tunisia

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Abstract

The current study aimed to analyze the camel meat sector in the western south of Tunisia (Kebili); and to determine the different actors in the camel meat value chain and the interweaving interactions between them. The survey used in this study involved a sample of breeders (18), butchers (7), slaughterhouses (2) and consumers (58). A mind map was drawn to position the actors and identify the relational flows between them in the camel meat value chain. The results showed that camel farming is organized in herds of varying size, and two herd groups were thus defined: one group of large-sized herds with an average of 94 ± 27 heads and a second group of medium-sized herds with an average of 34 ± 27 heads. The percentage of breeders managing large-sized herds was 56%, while those of medium-sized herds were 44%. Besides, the butchers are always the ones who slaughter the camels. The survey showed the presence of another influential actor in the camel meat value chain, the trader, whose role is highlighted through the establishment of the mind map, which revealed that the trader has a strong dependency relationship with the breeder and the butcher. Indeed, in order to have the raw material that is necessary for his business, the latter may purchase camels either from the trader or directly from the breeder in the livestock market. The mind map also showed a weak relationship between the official services and the breeder, the butcher, or even the absence of the trader. Moreover, two marketing channels have been identified using the mind map: a short channel (traditional) involving the breeder, butcher, and consumer, and a long channel (integrated) involving an additional actor, the trader, who might contribute to the increase of the meat price. In conclusion, this study showed that the value of the meat camel chain remains marginalized because of the multiplicity of stakeholders. This marginalization points to the fact that the intervention of the official services is diluted, in particular in the long channel, leading to clandestine trafficking and the marketing of uncontrolled camel meat.

Keywords: Actors, Camel Meat, Mind Map, Relational Flows, Value Chain.

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INTRODUCTION

Camel breeding has great economic importance in south Tunisia because of its cultural and heritage value. It represents an average of 79% of the income for breeders and 43% of the family work time for the population of the south (Tardif et al., 2014). It has several vocations, such as transportation, agricultural work, tourism, and meat, milk, and wool production (Ramadan and Inoue-Murayama, 2017). Also, as the camel is considered a resilient animal that can adapt to challenging environmental conditions, it maintains healthy products in complex territories (Arbi and Faye, 2019). In the dryland areas, where the management practices are traditional (Babege et al., 2021), camel rearing feeding is based on grazing pastoral resources, which involves sustainable products and thus a livelihood option for the population (Alemnesh et al., 2020; Kena, 2022). Regarding products, camel breeding is known for health products. In fact, for meat, Biesalski (2005) and Zeng and McGregor (2008) reported that most red meat increases consumer health problems, including high levels of triglycerides and cholesterol. In this regard, it was stated that the protein content of camel meat is higher, and the intramuscular fat is lower than that of veal. Thus, Camel meat is a valued food product known for its dietary qualities for human health (Kadim et al., 2008; Kammoun, 2011; Kadim and Sahi, 2018).

In Tunisia, especially for families in southern Tunisia, it also plays a substantial socio-economic role for the breeders in the region (Jaouad, 2009). The value of the camel meat chain is dominated by the informal sector, the multiplicity of actors, and the interference of their roles (Letayef, 2018). In addition to the complexity of the actors' roles, there are other constraints such as the lack of coordination and consequently, the lack of control and traceability of the camel product (FAO, 2013). Thus, the development of the camel sector and its products is linked to the identification of actors in the value chain, the definition of the relationships between them and the establishment of the strengths and weaknesses of each actor. Considering the value chain's importance in response to the increasing human population demand for livestock products, it is difficult to achieve a sustainable value chain due to system and market constraints (Neven, 2014).

In order to reach these goals, the present study carried out an analysis of the typology of camel breeding and a preliminary diagnosis of the camel meat chain value in the region of Kebili (southwestern governorate of Tunisia), where camel meat is valued as a significant source of animal proteins by the local consumers. Our findings contributed to determining the principal actors intervening in this sector and studying the extent of the relationships governing the camel meat value chain.

MATERIALS and METHODS

Study location

The study took place in the governorate of Kebili, located in the southwest of Tunisia and limited to the north by the governorates of Gafsa and Tozeur, to the south by the governorate of Tataouine, to

the east by the governorate of Medenine and the west by Algeria. Kebili is characterized by camel breeding activity. The study interested three districts: Douz, El Faouar, and Kebili (Fig. 1).

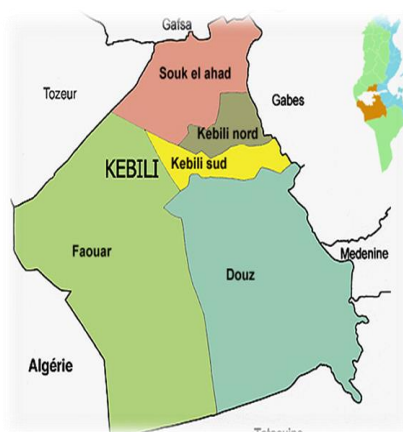


Figure 1. Study location: Douz, El Faouar, and Kebili districts (Southwestern Tunisia).

The governorate of Kebili is characterized by a desertic climate and low and irregular rainfall: the average annual rainfall is less than 100 mm, and the number of rainy days hardly exceeds 20 days/year. Besides, the average annual temperature is 21°C with a minimum of -3 °C in January and a maximum of +48°C in July (INM, 2023).

Survey

A sample of eighteen breeders, seven butchers, and fifty-eight consumers were individually interviewed face to face. The sampling was done randomly. Moreover, two slaughterhouses were visited to search for other possible camel chain value actors. The survey was based on three parts: *i*) the social data (gender, age, and education level), *ii*) information on camel breeding (ecotype, number of reared animals, and structure of the herd), and *iii*) economic data (number of heads marketed).

Determination of the camel meat value chain mapping

The relational flows between actors of the value chain were defined. A mind map was established using XMIND software (version 8). The objective of the mind map's establishment was to determine the exact place of the different actors within the chain and identify all their possible interactions and the significance of these relationships. Moreover, the marketing channels of the camel meat were determined from the value chain mapping.

Statistical analysis

Data collected from the survey were analyzed using SAS software (SAS[®], Cary, NC, USA). Frequency distribution, means and standard deviations were determined for the different variables. ANOVA was carried out using the General Linear Model (GLM) procedure to study the influence of districts on the number of customers and delivered carcasses. Then, the model was:

$$Y_{ij} = \mu + \text{District}_{ij} + \varepsilon_{ij}$$

Where:

Y_{ij} : number of customers and delivered carcass,

μ : the population mean,

ε_{ij} : the residual error.

The average comparison test was performed using the Student Newman Keuls test (SNK), and the significance level was set for $p = 0.05$.

RESULTS and DISCUSSION

Social results

The survey showed that camel breeding is a 100% masculine occupation and owning the herds, for women are never owners of camels in the governorate of Kebili. The district of Douz quartered the largest camel breeders, representing 72% of all breeders interviewed (Figure 2). Most of the debriefed breeders were in the over-50 age category (56%). In contrast, the rest of the breeders belonged to the category between 30 – 40 years (22%) and 41 – 50 years (22%) (Figure 3). This finding showed that camel herding and breeding is of interest to the older breeders versus the younger ones, which might be explained by the fact that they have access to ancestral know-how that the younger generations do not necessarily possess, and the reluctance of the youngest one to practice such a physically taxing profession and not economically rewarding. In this regard, Salmi et al. (2018) reported that camel breeding begins at the age of 28 years, with small herds that do not exceed 50 heads.

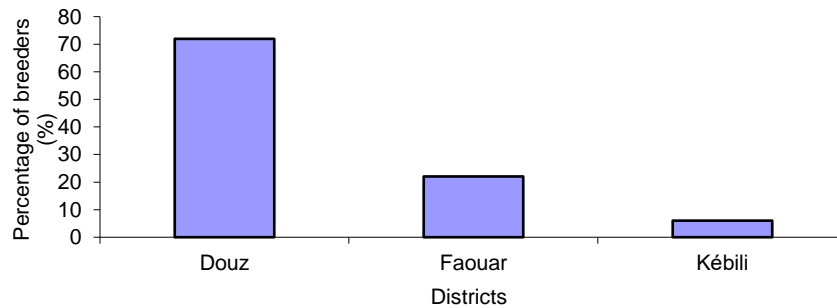


Figure 2. Distribution of the camel breeders according to their geographical location.



Figure 3. Camel breeder's distribution according to the age classes.

Regarding education (Figure 4), 56% and 28% of camel breeders were never schooled or had a primary education level, respectively. However, 11% and 5% of camel breeders had secondary and academic levels, respectively. In a recent study carried out in the south of Tunisia, Letaief and Bedhiaf-Romdhani (2022) found that 35% of breeders are illiterate, 27%, 29%, and 9% had a primary school, post-primary school, and academic levels, respectively. They even reported that most of them are owners only of camels.

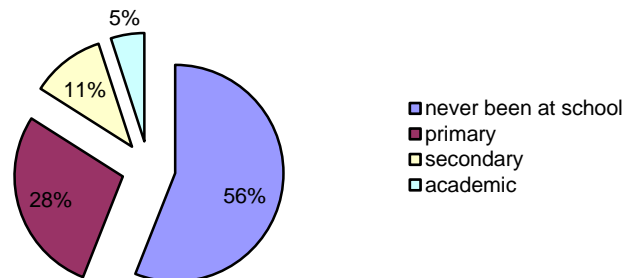


Figure 4. Distribution of camel breeders according to their education level.

Characterization of camel breeding

The results showed that camel farming is organized in herds of varying sizes. Indeed, two (2) breeding groups were defined in this study: the group of large-sized herds with an average of 94 ± 27 heads and the group of medium-sized herds with an average of 34 ± 19 heads. Besides, all of these herds are solely bred under extensive systems. In addition, the percentage of breeders with large-sized herds was 56%, while the percentage with medium-sized herds was 44% (Table 1). In Tunisia, the extensive system under which the camel herds are conducted is characterized by a diet based on natural resources (Moslam and Megdich, 1989; Moslah et al., 2004; Letaief and Bedhiaf-Romdhani, 2022). The breeding practices are almost only traditional due to feeding constraints (Ould Ahmed et al., 2009; Jemli et al., 2018). In another study, Tardif et al. (2014) reported that well-trained keepers manage camel rearing in

southern Tunisia using this practice. Salmi et al. (2015) outlined that camels are kept in an open-air system while they graze pastoral areas all day.

In this study, most of the breeders (95%) reported that their camels came from their families' inheritance. In comparison, only 5% of breeders started their breeding practice by buying animals from more oversized breeders. In Tunisia, Salmi et al. (2018) stated that 58% of breeders are inheritors and either agro-pastoralists or belong to family livestock households in the governorate of Kebili. Besides, each herd's daily work depends on the breeders' social and cultural organization in their territory (Alary et al., 2021).

Table 1. Camel population according to the size of herds

	Herd size	
	Herds \geq 70 heads	Herds < 70 heads
Overall average of the camel population (heads)	94 \pm 27	34 \pm 19
Percentage of breeders (%)	56	44

The studied herds showed that three ecotypes from the Marghrebi breed were identified in the governorate of Kebili, and according to their morphological characteristics, they were ranked by importance to Marzougui, Gueoudi, and Ghiloufi ecotypes (Figure 5). In Tunisia, there are different ecotypes based on morphological appearances and socio-geographic origins (Ould Ahmed et al., 2010). Burger et al. (2019) also reported five ecotypes of the Maghrebi camel breed. In fact, in a previous study carried out in the south of Tunisia, Chniter et al. (2013) reported that the Marzougui, Gueoudi, and Ghiloufi ecotypes are reared in Kebili in southwestern Tunisia by the communities of Beni Marazigues, Ouled Gharib and Beni Ghilouf, respectively; whereas, there is another ecotype Ourdhaoui, reared in the south - est of Tunisia by the communities of Tawazins and Oudarna. Letaif and Bedhiaf-Romdhani (2022) found the same three ecotypes in Kebili with a high proportion of the Marzougui ecotype (84%).

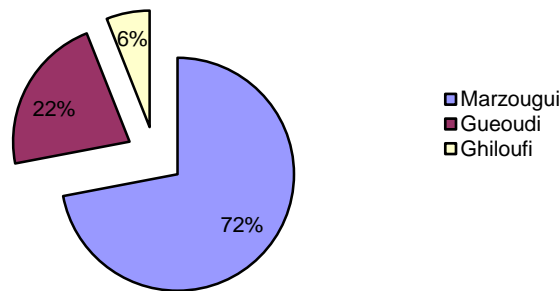


Figure 5. Distribution of camel ecotypes in the governorate of Kebili

Camel meat value chain

Breeder's customers

The breeder's customer categories (Figure 6) were composed of the trader (55%) and the butcher (6%). However, according to the breeder's perception, the butcher could also be the trader simultaneously (39%).

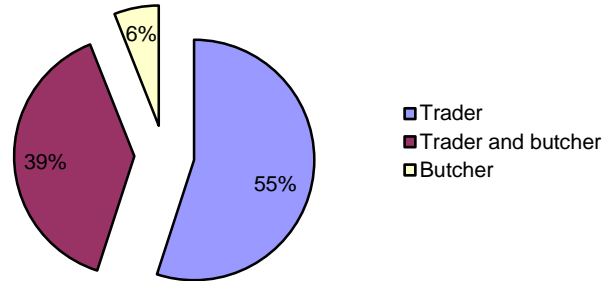


Figure 6. Categories of breeders' customers.

The average number of camel heads marketed was 3 ± 1 per month (Fig. 7). This marketing is low compared to others species such as bovine or ovine and could be attributed to the consumption of the camel meat. In North Africa, the consumption of camel meat was estimated to be about 2.8 kg/inhab/year (Faye et al., 2014). The low consumption could also be attributed to regular unavailability and the informal sector of camel meat (Letayef, 2018; Bourgherara et al., 2023).

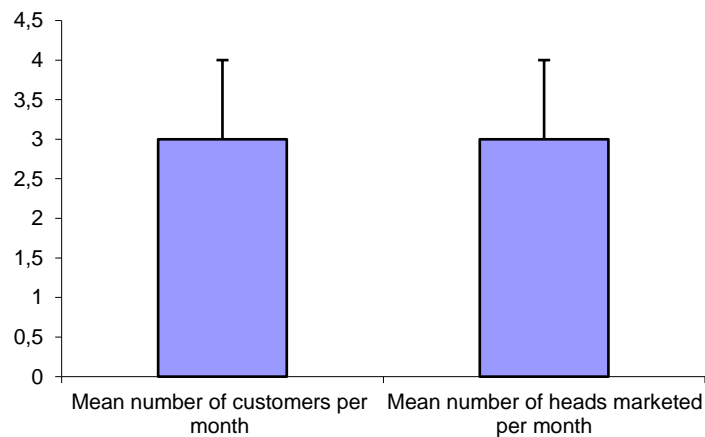


Figure 7. Number of breeders direct customers and camel heads marketed (Means \pm SD).

Butcher

The survey showed that butchers are always the ones who slaughter the camels. Eighty percent (80%) of those slaughtering the animals are professional butchers, while the rest (20%) are traders. They sacrifice the animals in the vicinity of their butcher shops without referring to any sanitary inspection of the meat in the organized framework of the municipal slaughterhouses. Our result agreed with those advanced by Salmi et al. (2017), who reported that the butcher is the primary actor in the camel meat value chain. Indeed, he can buy live animals, slaughter the animals, and market the camel meat to consumers. He controls and dominates the camel meat sector (Mohamed Ali, 2016). Brahimi et al. (2020), in their study on camel meat sector, found that butchers are the most influential actors in this value chain; their level of integration and specialization in the formal camel meat sector depends on the butcher's age group. In our study and according to the result presented in Fig. 6, the butcher could also be the trader. This multiple-hatted actor showed a non-specialization of stakeholders of the camel meat sector and led to confusion of roles (Alary et al., 2021). Hussein et al. (2013), in their study on the camel meat value chain in Pakistan, found that butchers have a net margin higher than that of the other stakeholders when they slaughter camels on their own.

According to the survey, butchers reported that they have a daily visits of higher customers ($p < 0.05$) in the district of Kebili (Figure 8). Although the district of Douz accounted for the most significant number of camel breeders, it seems that butchers are concentrated in the district of Kebili. This could be attributed to the presence of the livestock market in this district.

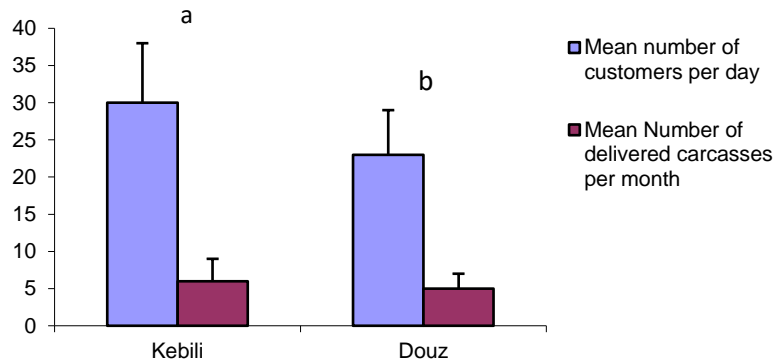


Figure 8. Number of butcher customers and delivered camel carcasses (Means \pm SD).

a,b : $p < 0.05$

Consumer

The results showed that the consumers who buy camel meat from the butcher are 55% women, as they usually are in charge of the grocery shopping in the family. Most consumers belong to the age class

between 31-50 years, with 27% women and 28% men of all the consumers (Figure 9). Only 6% of the interviewed consumers purchase once a week the camel meat, while 49% and 45% of consumers acquire the camel meat rarely or once a month, respectively (Figure 10). Hence, the consumer is not motivated to a regular use of the camel meat in his routine dietary. He prefers the others types of red meat such as sheep or goat. For this reason, camel meat is considered a secondary interest as well as the animal (FAOSTAT, 2020). The lack of demand for camel meat can be attributed to the culinary habits of the region's inhabitants, who have a particular preference for goat and sheep meat, in addition to the irregular availability of camel meat, which depends on the availability of animals ready for slaughter.

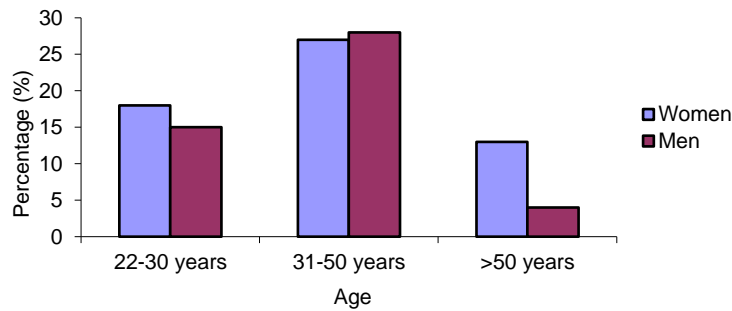


Figure 9. Consumers' distribution according to the age classes.

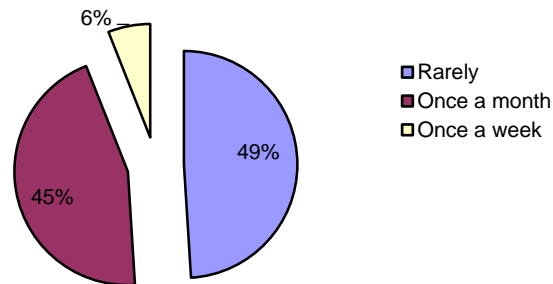


Figure 10. Frequency of consumption of camel meat.

According to the consumers (Figure 11), 55% of them report that their camel meat choice is due to its qualitative characteristics. Other consumers (36%) said their purchase is a part of their culinary diversification. Nevertheless, 6% and 3% of consumers reported their interest in camel meat purchases is due to its low price compared to other red meat sources and camel meat's quality/price ratio. Faye et al. (2013) advanced that in Tunisia, camel meat is considered a by-product compared to dairy production, and camel meat consumption is related to quantity rather than quality, especially during familial events. Brahimi and Senoussi (2020), in their study on camel meat consumption in Algeria, found that most consumers were urban (61.8%), while the rural ones purchased only camel meat (9.8%). They also reported that camel meat is consumed less than bovine meat. In this regard, the preference

shift could be successful when camel meat properties are highlighted to the general public to promote its consumption as an alternative healthy food (Kadim et al., 2022).

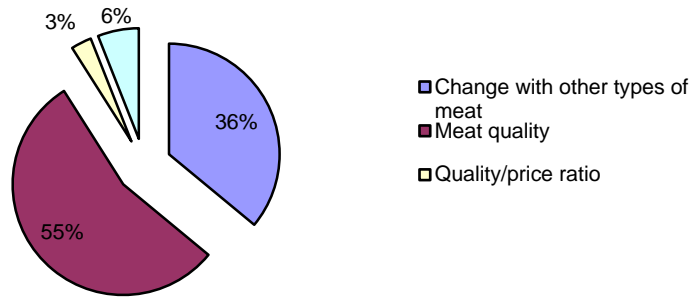


Figure 11. Reasons for consumption of camel meat.

In addition to the farmers, butchers/slaughterers, and consumers, the survey revealed the presence of another impacting actor in the camel meat value chain, which is the trader (Figure12). The latter often intervenes during the purchase and sale transactions with the breeder, butcher and/or slaughterer. The mind map showed a relational solid flow of the trader with livestock market, breeder butcher, and/or slaughters. However, relational flow still needed to be determined with the official services. In addition to the complexity and the interference of the trader's role with the butcher or slaughter, this latter contributes to the marginalization of the camel meat chain value. Bougherara et al. (2023) reported that camel slaughtering usually happened outside the official channels.

The mind map of the value chain showed that the breeder has, on the one hand, a robust economic relationship of dependency with the trader and, on the other hand, a medium relationship with the butcher, who can acquire camels either from the trader or directly from the livestock market of the region. In another study carried in Tunisia, Alary et al. (2021) reported that the traders are often the herders or the fattening specialists.

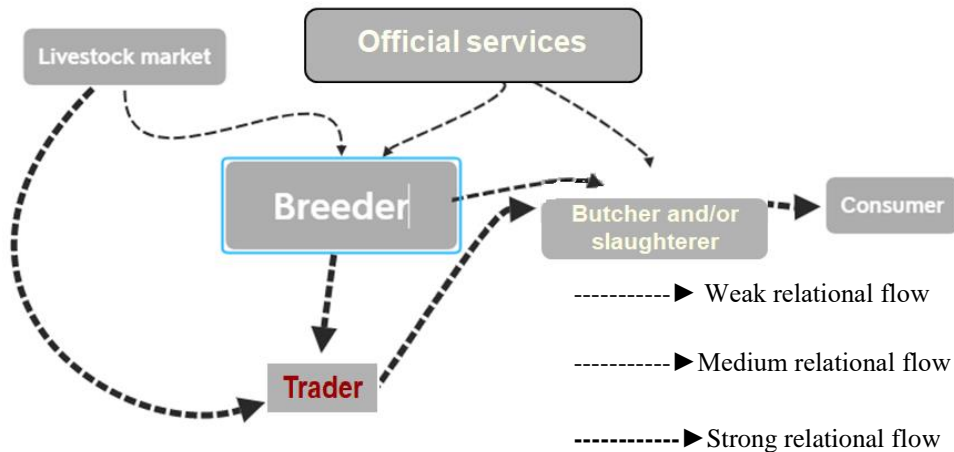


Figure 12. Mind map showing the relational flows and their degree of importance between the different actors of the camel meat value chain.

Despite the complexity and the interference of the actors of the camel meat value chain that have been shown above, the mind map identified two main channels for the marketing of camel meat in the region: *i*) the short channel (traditional), characterized by the direct sale of the product (camel meat) from the breeder to the butcher and then to the consumer, *ii*) the long channel (integrated), characterized by a strong involvement of the trader. The latter dominates the camel meat chain value in Kebili and could increase the product's final price (Figure 13).

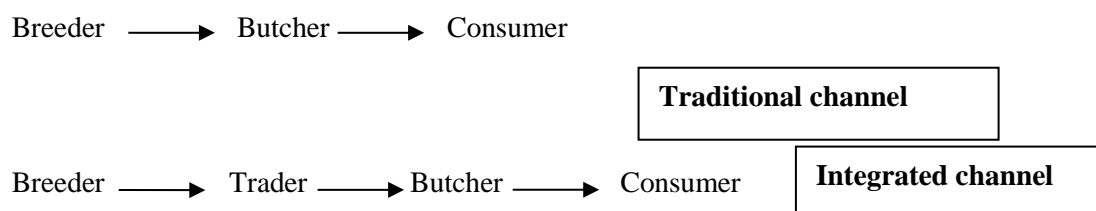


Fig. 13. Marketing channels for camel meat

Conclusion

The assessment of actors in the camel meat value chain and their relational flows in the governorate of Kebili in southwestern Tunisia showed that the camel sector remains marginalized because of the multiplicity of stakeholders. This marginalization showed that the official services' task is diluted, particularly in the long channel. Thus, it leads to clandestine trafficking and marketing of uncontrolled camel meat. An excellent interest should be given to the official services of camel breeders, who are the weak actors in this value chain. It is also wise to think about establishing a schedule of vulgarisation to convince consumers to buy camel meat. One of the most important solutions to improve production and consumption is encouraging breeders to organize themselves to defend their camel husbandry's goals and control the camel meat value chain. This led to shortening the marketing of the camel meat channel and avoiding specialized stakeholders who contributed to the chain's flow complexity and the increasing price of the camel meat at the sale.

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