Biofunctional potential and utilization of camel hump fat: traditional knowledge and scientific perspectives

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Summary

Background: Camel hump fat is a natural resource with multiple applications. It is used for traditional, medicinal, cosmetic, and nutritional purposes. Despite its historical significance, little scientific research has been conducted on its economic potential and its changing role in contemporary society. In order to optimize the use of camel hump fat, we need to further our understanding of the interplay between traditional practices and modern markets. ***Aim***: This study examines traditional practices, market dynamics, and socio-cultural factors influencing the use of camel hump fat in Algeria's Ouargla region. We reveal critical gaps in the literature regarding this natural resource. ***Methods***: We adopted a mixed-method approach, which included an analysis of production data. Surveys were conducted with 200 consumers and 80 butchers and sellers. Usage patterns and market trends were evaluated using principal component analysis. ***Results***: The data revealed a significant decline in production, from 332.3 tons in 2020 to 144.5 tons in 2022, with price variations between 70–120 Algerian dinars (DA), equivalent to €0.48–0.83. We highlighted the disparity between theoretical knowledge and practical applications across demographic groups. We found that the use of camel hump fat among educated younger men was limited, whereas older women use it regularly, despite their lack of formal education. Camel fat is a multifunctional resource with applications in three principal fields: medical/therapeutic (treating joint pain, respiratory conditions, etc.), cosmetic (hair care, anti-aging, etc.), and culinary/nutritional. Our observations show that usage patterns are influenced by education level, cultural background, and personal experience, with a clear generational divide in terms of traditional practices. ***Conclusions***: These findings highlight the interaction between traditional knowledge and modern scientific approaches. Our analysis sheds light on the changing role of traditional products in contemporary society.

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■ INTRODUCTION

The one-humped camel or dromedary, *Camelus dromedarius*, plays a crucial role in desert societies, where they represent an important economic asset. Camel hump fat provides biologically active compounds of potential medical importance (Senoussi *et al*., 2024). Its unique composition and potential applications have generated growing scientific interest (Muzamil *et al*., 2024; Ali *et al*., 2019; Abrhaley & Leta, 2018; Guo *et al*., 2019; Tharwat *et al*., 2023).

The camel hump, which is primarily composed of fat, is a rich source of beneficial fatty acids. These include oleic and linoleic acid, which are known for their anti-inflammatory and tissue-regeneration properties (Guo *et al*., 2019; Li *et al*., 2023; Mashaly *et al*., 2020). Traditionally,

camel hump fat was used in folk medicine for treating wounds and burns, as well as for improving skin health. Recent studies suggest that when incorporated in topical creams and skin moisturizing lotions, it has the potential to accelerate wound healing, particularly in the case of sunburn and UV damage (Ali *et al*., 2019; Jassim *et al*., 2018).

Despite its reported benefits, there are significant gaps in research on the traditional uses of camel hump fat, particularly from the perspective of communities that relied on camel-derived products historically. Given the rapid advances in biomedicine and biocosmetics, documenting and using traditional knowledge to develop innovative applications has become increasingly important.

This study explores the traditional practices related to the use of camel hump fat in desert areas, with a particular focus on the Ouargla region in Algeria. It examines the importance of this natural resource for local communities and the factors influencing its diverse applications. Our research provides new insights into the scientific and economic importance of camel hump fat, and discusses its potential value for different industries.

■ MATERIAL AND METHODS

Study area description

Ouargla Province covers a vast area of 136,787 km² in southeastern Algeria (Figure 1). It lies between latitude 31°57'N and 31°59'N and longitude 5°19'E and 5°20'E, based on the Greenwich meridian (Google Earth, 2025).

The region is characterized by simple geographical and topographical features, comprising lowlands and extensive sandy plains. The climate is predominantly arid, with dry conditions during approximately ten months of the year (Trade and Export Promotion Division of Ouargla Province, 2025).

Livestock farming is a key economic activity in the region. Camel breeding ranks second after goat farming, accounting for 19,450 head in 2022 according to the Algerian Ministry of Agriculture and Rural Development (2023). Camel meat production is a prominent sector in Ouargla, which has one of the largest camel slaughterhouses in southern Algeria and an important camel market. The annual production output from camel-related activities is estimated at 1,314 tons.

Given the region's unique climatic and geographical conditions, as well as its strategic importance for camel breeding and meat production, Ouargla Province was selected as the focus area for this study.

Survey design and methodology

The survey was carefully structured to explore the multiple applications and perceptions associated with camel hump fat among consumers. A combination of open-ended and closed-ended questions allowed us to collect precise and comprehensive data, reflecting the various dimensions of this unique resource. These include traditional practices, perceived medicinal properties, cosmetic and nutritional benefits. By drawing on participants' personal experiences and culture, we also identified their levels of awareness regarding its traditional and contemporary uses.

The questionnaire was divided into distinct sections, each focusing on a specific aspect of camel hump fat usage. These sections included: (i) *Nutritional Applications*: Participants were asked about their knowledge and use of camel hump fat as a dietary component, including its perceived health effects and its role in traditional and modern culinary practices. (ii) *Perceived Medicinal Properties*: This section examined participants' beliefs and knowledge with regard to the therapeutic properties of camel hump fat, its traditional uses and its perceived relevance in modern applications. (iii) *Cosmetic Applications*: Questions in this section explored the use of camel hump fat in skin care and beauty products, including participants' experiences and perceptions of its effectiveness. (iv) *Awareness and Perception*: This section assessed participants' awareness of the traditional and emerging uses of camel hump fat, highlighting its significance in various cultural and industrial contexts (Suppl. Mat. 1).

The survey design ensured that respondents could freely express their opinions, while also providing structured data for quantitative and qualitative analyses. We included different question types to capture

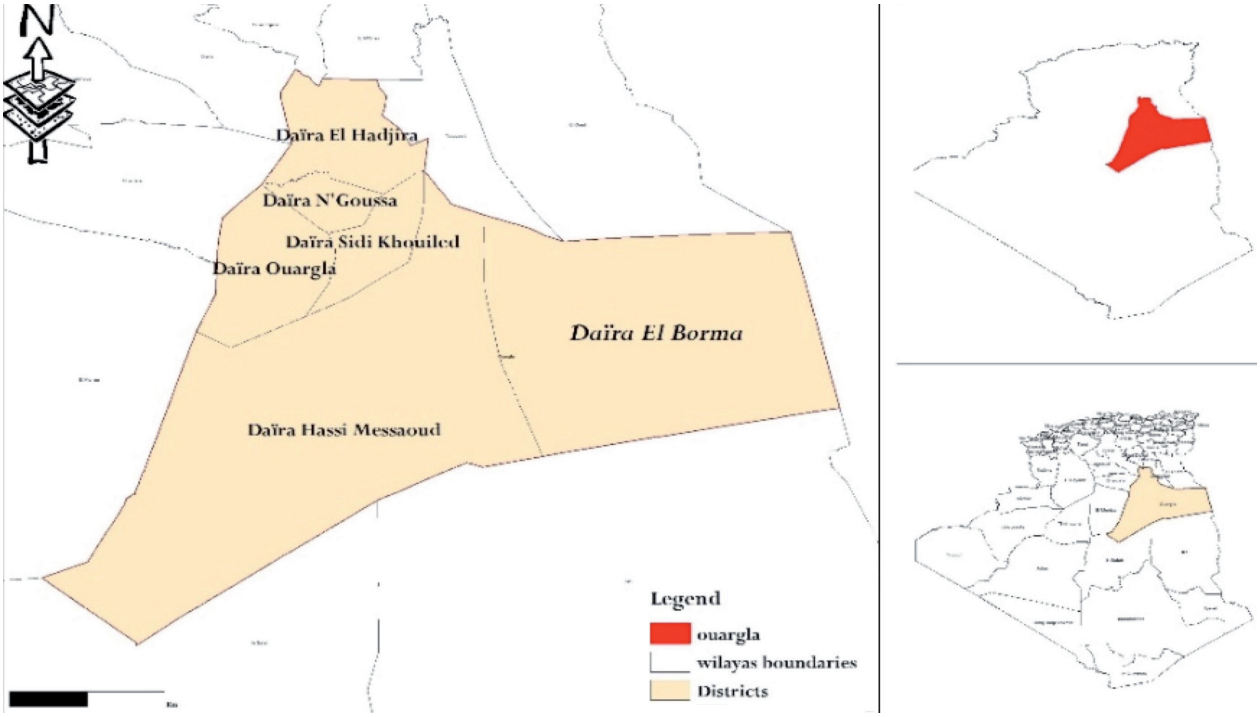

Figure 1: Location of the study area /// *Localisation de la zone d'étude*

measurable trends, as well as nuanced insights into consumer attitudes and practices. This approach provided a holistic perspective on camel hump fat usage, giving researchers a solid foundation for in-depth analysis. The different thematic sections facilitated the organization and interpretation of data, and improved our understanding of the subject matter.

Study sample

The study sample was carefully designed to encompass a diverse range of perspectives. This provided a comprehensive understanding of camel hump fat usage. Two key groups were included in the sample: direct consumers and butchers/sellers. Each group provided unique insights into the collection, preparation, trade, and consumption of camel hump fat.

The study was conducted in consultation with the Algerian Ministry of Agriculture and Rural Development (MADR). It concerned the districts and municipalities of Ouargla Province, including: Rouissat, Ouargla, Hassi Messaoud, N'Goussa, Sidi Khouiled, Ain Beida, Hassi Ben Abdallah, El Hadjira, and El Barma. The samples were randomly distributed in these municipalities and districts to ensure adequate representation of the various geographic and socio-economic contexts.

Sample composition

Data on camel hump fat production in the Ouargla region from 2019 to 2022 was provided by officials at the Ministry of Agriculture and Rural Development. This allowed us to identify production trends with accuracy. A total of 80 butchers/sellers and traders with hands-on experience in collecting, preparing, and selling camel hump fat in desert markets were included. Their practical knowledge allowed us to explore the trade dynamics in depth, as well as the factors influencing product quality, and consumer demand. The sample comprised also 200 participants (direct consumers) from various age groups, cultural backgrounds, and geographic locations. This group provided valuable information about the medical, nutritional, and cosmetic applications of camel hump fat, as well as their personal experiences, preferences, and awareness of its beneficial properties.

Data collection procedures

To ensure comprehensive data collection and to reach the largest possible number of participants in the region, the survey was distributed using multiple methods tailored to the study sample's characteristics.

• For officials from the Ministry of Agriculture and Rural Development

Statistical questionnaires were submitted using electronic communication channels. Officials were asked to fill in the numerical tables on camel hump fat production in the Ouargla region during the period 2019-2022.

• For consumers

The survey was distributed using a combination of: (i) *Direct communication channels*: Personal interviews were conducted with participants, allowing for detailed responses and clarification, when necessary. (ii) *Online distribution*: To reach a broader audience, particularly those who could not be accessed in person, the survey was shared using online platforms. This facilitated participation from a wider demographic sample, which generated a more diverse and representative dataset.

• For butchers and camel fat sellers

Data was collected during direct field visits to shops and markets where camel fat is sold. Specifically: (i) *Popular markets*: One of the primary data collection sites was the Saturday market in Ouargla, a well-known gathering point for specialized camel meat and fat sellers. (ii) *Personal interviews*: In-person interviews were conducted with butchers and traders in the different meat markets at Ouargla. They provided detailed insights into the collection, preparation, and sale of camel hump fat, as well as valuable practical knowledge about trade practices, market dynamics, and consumer preferences.

Statistical analysis

All responses were meticulously documented to ensure that our analysis was accurate and reliable. The data collected from 200 consumers and 80 butchers/sellers were analyzed using Multiple Correspondence Analysis (MCA). The aim was to identify patterns and relationships between variables, particularly regarding demographic factors, consumer behavior, market availability, and perceptions of camel hump fat. The variables used for the statistical analysis are presented in Table 1 for consumers and in Table 2 for butchers and camel fat sellers.

By setting a significance level of $p < 0.05$, we only considered statistically significant results. Standardized coefficients, including standard errors, t-values, p-values, and 95% confidence intervals were used to compare variables across different categories. The analysis was conducted using XLSTAT, Perpetual version 2019.2.2, 59614, for Microsoft Excel 16.0.17231 (64-bit).

■ RESULTS AND DISCUSSION

Market dynamics associated with camel hump fat in Ouargla region

Market dynamics between 2019-2022

The market dynamics for camel hump fat in the Ouargla region between 2019 and 2022 show fluctuations, with a production peak in 2020 followed by a sharp decline (Figure 2).

In 2019, camel hump fat production was 317.24 tons. It increased to 332.31 tons in 2020, the highest level recorded during the observed period. This upward trend was short-lived. In 2021, production fell to 263.78 tons, approximately 20.6% less than in 2020. In 2022, it plummeted further to 144.54 tons. This represents a 45.2% decrease from 2021 and a 56.5% reduction from peak production in 2020.

This downward trend may be due to numerous factors, including: changes in camel population dynamics and slaughter rates; environmental conditions, such as drought, feed scarcity, or disease outbreaks; economic factors, like fluctuations in market demand, and the introduction of sustainable production practices and regulatory restrictions in the camel meat industry (Imelhayene et *al*., 2022).

Price variations and consumer behavior

The multiple correspondence analysis (MCA) of the butchers' survey data is shown in Figure 3. It reveals distinctive patterns in the availability, price, and consumer demand for camel hump fat. The analysis reveals significant explanatory power, with the first two dimensions (F1 and F2) combined accounting for 56.40% of the total variance (F1: 40.43%, F2: 15.96%). When F1 and F3 are examined, they explain 44.20% of the variance, while F3 contributes only 3.77%. The distribution of variants forms clear clusters, with relevant responses, such as Q6-1 and Q2-2, consistently clustered on the positive side of the F1 axis in both charts. Other variants show localized variations, such as Q6-3. These clustering patterns suggest structural correlations between response categories. This reflects a coherent framework for butchers' perceptions regarding the characteristics of camel hump fat. The significant explanatory contribution of the F1 dimension highlights its crucial role in terms of distinguishing response patterns. Overall, the results of the multidimensional analysis provide a strong

Table 1: List of variables and modalities, and percentages by modality used in the multivariate analysis for consumers /// *Liste des variables et modalités, et pourcentages par modalité utilisés dans l'analyse multivariée pour les consommateurs*

Variable name	Code	Value	% by modality
Age groups	age_groups-1	Under 20 years	10.280
	age_groups-2	20 to 30 years	51.402
	age_groups-3	30 to 40 years	19.626
	age_groups-4	More than 40 years	18.692
Education Level (Q2)	Q2-2	High School	11.215
	Q2-3	Middle School	6.542
	Q2-4	Primary	3.738
	Q2-5	University	78.505
Gender (Q3)	Q3-2	Female	71.028
	Q3-3	Male	31.776
Experience of use (Q4)	Q4-2	Used personally	31.776
	Q4-3	Heard about it	68.224
Purpose of use (Q5)	Q5-2	Cosmetic	7.477
	Q5-3	Other	3.738
	Q5-4	Food	41.121
	Q5-5	Therapeutic	47.664
Instructions for use (Q7)	Q7-2	Eating	36.449
	Q7-3	Other	13.084
	Q7-4	Massage oil	50.467
Duration of use (Q9)	Q9-2	Daily	68.224
	Q9-3	Weekly	31.776
Usage method (Q10)	Q10-2	On its own	28.972
	Q10-3	On its own or mixed	15.888
	Q10-4	With other ingredients	17.757
	Q10-5	Depending on the health problem	37.383
Duration of treatment (Q12)	Q12-2	One week	59.813
	Q12-3	One month	40.187
Proven effectiveness of treatment (Q14)	Q14-2	No	7.477
	Q14-3	Yes	92.523
Treatment effectiveness (Q15)	Q15-2	Effective alone	57.009
	Q15-3	Or by adding other ingredients	42.991
Preferred method or best treatment method (Q16)	Q16-2	Eating	27.103
	Q16-3	Massage oil	72.897

Table 2: List of variables and modalities, and percentages by modality used in the multivariate analysis for butchers and camel fat sellers /// *Liste des variables et modalités, et pourcentages par modalité utilisés dans l'analyse multivariée pour les bouchers et les vendeurs de graisse de chameau*

Variable name	Code	Value	% by modality
Sales of camel hump fat (Q1)	Q1-1	Yes	100.000
Interest level (Q2)	Q2-1	High interest	76.667
	Q2-2	Reasonable interest	5.000
	Q2-3	Limited interest	18.333
Consumer category (Q3)	Q3-1	Elderly	56.667
	Q3-2	Youth	43.333
Available year-round (Q5)	Q5-1	No	5.000
	Q5-2	Yes	95.000
Quantity availability (Q6)	Q6-1	Large	11.667
	Q6-2	Considerable	80.000
	Q6-3	Limited	8.333
Price range (GPRIX)	GPRIX-1	DA70-DA95	18.333
	GPRIX-2	DA95-DA120	45.000
	GPRIX-3	DA120-DA140	36.667

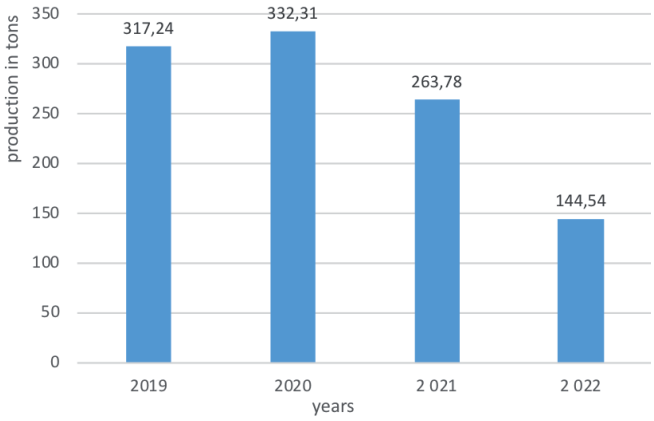

Figure 2: Variation in camel hump fat production in tons between 2019 and 2022 in Ouargla region, Algeria /// *Variation de la production de graisse de bosse de chameau en tonnes entre 2019 et 2022 dans la région de Ouargla, Algérie*

basis for understanding the dynamic market factors influencing the distribution of camel hump fat. They show how price sensitivity, demographic variables, seasonality, age, and social habits affect purchasing behavior.

The results reveal a complex pattern in terms of the availability and commercialization of camel hump fat. The data indicate that camel hump fat was available on the market throughout the year, with significant seasonal variations in quantity. The fluctuations correspond to different slaughter and production cycles, which directly affect market supply. Camel hump fat prices range considerably, from €0.48 to more than €0.82 (70–120 Algerian dinars), which influences consumer behavior across different age groups.

At the positive end of the F1 axis, the demand for camel hump fat at prices above €0.82 (DA120) is low, despite the high availability. This higher price category is primarily favored by young consumers. Even when fat prices are high, they tend not to negotiate with sellers to avoid conflicts. Their buying behavior is driven by urgency and reflects their preference for convenience over cost considerations.

Conversely, at the negative end of the F1 axis, fat priced between €0.48 and €0.65 (DA70 and DA95) shows high availability and strong demand, especially among older consumers, who frequently use camel hump fat. Unlike younger buyers, older people adopt a smarter buying strategy. They prefer bargaining and looking for reasonable prices. This generational difference in consumer behavior highlights the

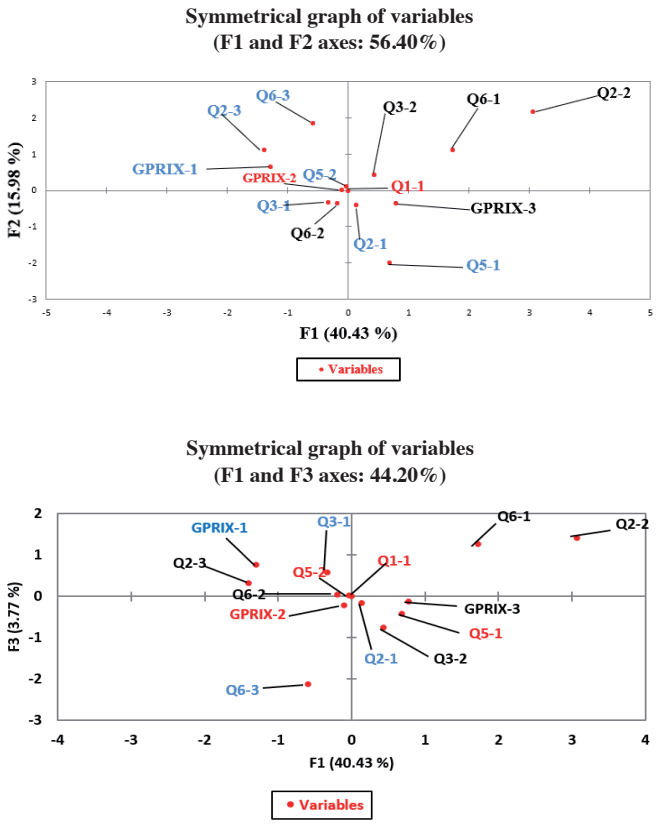

Figure 3: Projection of the modalities of variables contributing to the first factor (black) and the second factor (blue) in the symmetrical MCA graph of camel hump fat, based on butchers' survey /// *Projection des modalités des variables contribuant au premier facteur (en noir) et au deuxième facteur (en bleu) dans le graphique symétrique de l'ACM de la graisse de la bosse du chameau, sur la base des informations recueillies auprès des bouchers*

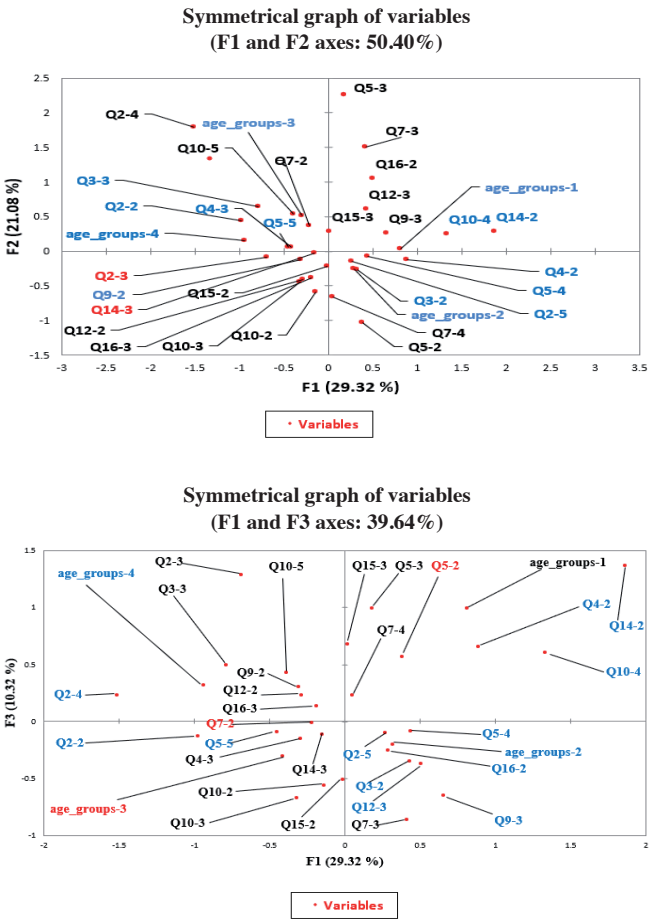

Figure 4: Projection of the modalities of variables influencing consumer behavior: contributions of the first (blue) and second (black) factors in the factorial plan of multiple correspondence analysis (MCA) /// *Projection des modalités des variables influençant le comportement du consommateur : contributions du premier (en bleu) et du deuxième (en noir) facteur dans le plan factoriel de l'analyse des correspondances multiples (ACM)*

economic prudence and traditional purchasing habits of older individuals, who are more accustomed to bargaining in local markets.

These findings emphasize the major influence of seasonal, generational and social factors on local market dynamics. The observed variation in demand suggests the need to adjust product distribution strategies to optimize market sales. By aligning pricing and marketing strategies with consumer preferences, vendors can achieve a better balance between supply and demand. This would ultimately improve profitability and accessibility to different consumer groups.

Our findings provide valuable insights, which could help butchers, retailers and policymakers grasp the economic and behavioral patterns governing the camel hump fat market. A more targeted approach to pricing, marketing, and distribution could boost market sales, while catering to the distinct preferences of younger and older buyers in the Algerian market.

Variations in camel fat usage

The Multiple Correspondence Analysis (MCA), based on three principal axes (F1, F2, and F3), captures various dimensions of individual behavior and knowledge regarding camel fat usage. These dimensions are shaped by age, gender, and education level, as illustrated in Figure 4.

Figure 4 presents two symmetrical plots derived from MCA methodology, depicting relationships between categorical variables related to consumer behavior. The upper plot (F1 vs. F2) accounts for 50.49% of the total variance, with F1 contributing 28.57% and F2 21.08%. Points in close proximity indicate correlations between categorical responses. The lower plot (F1 vs. F3) explains 39.64% of the variance, with F1 contributing 29.32% and F3 10.32%. It also distinguishes between generational and educational influences.

The analysis reveals a gap between theoretical knowledge and practical application. While younger, educated men acknowledge camel fat's medical and cosmetic benefits, they rarely use it in their daily lives. They tend to prefer scientifically proven alternatives. In contrast, older women use camel fat regularly, particularly for therapeutic and cosmetic purposes. They rely on inherited knowledge, rather than formal scientific proof. The F1 axis (29.32%) highlights this divergence: positive values correspond to younger, university-educated men with extensive knowledge, who seldom use fat. The negative values correspond to older women, who do use camel fat in their daily lives, despite their lack of formal education.

The F2 axis (21.08%) further emphasizes application patterns. Women over 40, especially those with primary education, use camel fat frequently. They often mix it with other substances to enhance its effects. They believe in its health benefits, and incorporate it in their diet and traditional remedies. Scientific research confirms its nutritional and therapeutic properties. Camel fat contains essential fatty acids, fat-soluble vitamins, and bioactive compounds (Nasser *et al*., 2015; Sahraoui *et al*., 2015; Sbihi *et al*., 2013; El Khasmi *et al*., 2023; Mashaly *et al*., 2020; Jassim *et al*., 2020). Fat can be combined

with other compounds, such as honey or medicinal herbs, which may enhance its healing potential.

Field studies highlight that camel fat has a beneficial role in skin care, particularly in hydration, elasticity, and dermatological health. Bioactive compounds improve the skin barrier function and reduce trans-epidermal water loss, especially when combined with oils, such as olive or argan oil (Nili, 2021). Many individuals rely on empirical evidence drawn from personal experience. However, controlled clinical studies are required for scientific validation.

The F3 axis (10.32%) distinguishes between traditional and modern applications. Older individuals have adopted traditional practices, whereas younger generations experiment with new uses. They incorporate camel fat into cosmetics and alternative treatments. The different practices are shaped by several key factors:

Education and scientific orientation: individuals with a higher level of education have a preference for scientifically validated products over traditional remedies (Behnam *et al*., 2021).

Cultural and influences: older women, especially in rural areas, continue to use camel fat based on inherited knowledge.

Economic accessibility: camel fat remains an affordable option, while wealthier individuals prefer medically approved products.

Experience vs. scientific validation: older women trust its efficacy as a result of direct experience, whereas younger men are more skeptical due to the limited research.

Natural vs. synthetic preferences: younger women increasingly favor natural skin care alternatives, while men prioritize synthetic, scientifically tested products.

Cultural transformations: exposure to global trends leads younger individuals to explore modern alternatives, despite acknowledging the benefits of camel hump fat (Chen *et al*., 2016).

Generational dietary shifts: younger generations favor industrial fats over traditional animal fats as a result of globalization and Western dietary patterns (Jiang *et al*., 2022).

Continued traditional use: older women continue to use camel fat for health and beauty, according to traditional practices.

Innovation in use: younger generations explore its application in cosmetics and experimental treatments.

Overall, camel fat usage reflects a balance between tradition and modernization. While older individuals rely on their direct experience and cultural heritage, younger generations tend to be more selective. Their behavior is shaped by their education and global influences. Indeed, they seek scientific validation before using camel fat on a regular basis.

Applications of camel hump fat: a multifunctional resource for medicine, cosmetics, and nutrition

Camel hump fat is a versatile natural resource with applications in medicine, cosmetics, culinary traditions, and general use (Nili, 2021). Table 3 categorizes its benefits based on traditional knowledge provided by the survey responses.

Renowned for its purity, camel hump fat is largely free from contaminants and heavy metals (Sbihi *et al*., 2013; Mohammed *et al*., 2020). Its quality depends on three factors: (1) the camel's diet and origin (wild or domesticated), (2) extraction and storage methods, and (3) its unique nutritional profile, particularly in the hump, kidneys, and mesentery. It is rich in natural fatty acids, with low cholesterol (80mg per 100g) and high oxidative stability, which makes it ideal for meat preservation (Mashaly *et al*., 2020). Additionally, it contains essential minerals (phosphorus, sodium, potassium, calcium), and vitamins D and E (Moussahil *et al*., 2023; Jassim *et al*., 2018). Hadipour *et al*. (2014) reported that camel fat does not have a significant impact on blood glucose, triglycerides, or cholesterol levels. This important finding highlights its potential as a safe dietary fat, when properly sourced.

In traditional medicine, as suggested in our study, camel fat is used to treat inflammatory conditions, respiratory problems, digestive disorders, and skin ailments. Applied topically, it relieves joint pain, rheumatism, and nerve discomfort. Mixed with honey or herbs, it soothes asthma, congestion, and ulcers. It also aids wound healing, reduces irritation from insect bites, and is considered to enhance bone health.

In cosmetics, camel fat is prized for its hydrating and anti-aging properties. It nourishes the scalp, strengthens hair, and prevents dandruff. In skin care, it enhances elasticity, deeply hydrates, and helps reduce wrinkles, chapped lips, and cracked heels, making it a key ingredient in natural beauty treatments.

Culinary use of camel fat is deeply rooted in tradition. It enhances flavor and texture, provides energy in harsh desert environments, and extends the shelf life of perishable foods.

Camel fat also has other practical applications. It is used in livestock feed for weight gain and energy, and it helps retain body warmth in colder climates. This multifunctionality means it is valuable in various domains.

■ CONCLUSION

Camel hump fat is a versatile resource with applications in medicine, cosmetics, and the food industry. Its use is shaped by multiple interconnected factors, including generational knowledge gaps, cultural traditions, dietary habits, and changing consumer preferences. Economic conditions, price fluctuations, and seasonal availability influence purchasing behavior. Older consumers value affordability, while younger generations prioritize convenience. Media exposure and the growing demand for natural products also impact consumer perceptions and market trends.

Although camel fat has long been used in traditional medicine and food preparation, comprehensive laboratory research is required to characterize its biochemical composition and health effects. Joint research projects involving scientists and traditional knowledge holders could bridge the gap between heritage and scientific innovation. For example, evidence-based studies and public awareness campaigns could enhance product credibility and acceptance in contemporary health and commercial sectors. In addition, the application of sustainable production practices and regulatory frameworks is essential for market stability and product quality. By integrating traditional wisdom with scientific advances, camel hump fat would gain recognition as a valuable resource that preserves cultural heritage, while creating new economic opportunities.

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Conflicts of interest

The authors declare no competing interests.

Table 3: Camel fat applications /// *Applications de la graisse de chameau*

Category	Application	Preparation Method	Benefits
Medical and Therapeutic Uses	Joint pain, rheumatism, arthritis	Melted fat massaged on affected areas, sometimes mixed with essential oils (e.g., black seed oil)	Anti-inflammatory, improves circulation, lubricates joints
	Asthma, chest congestion, cough	Mixed with honey, ginger, or herbal infusions and consumed warm	Opens airways, soothes irritation, reduces mucus
	Burns, wounds, skin diseases (eczema, psoriasis)	Directly applied after melting, sometimes mixed with aloe vera or honey	Forms a protective barrier, speeds up wound healing
	Stomach issues (ulcers, indigestion)	Consumed in small amounts with warm water or medicinal herbs	Coats stomach lining, aids digestion, reduces acidity
	Hemorrhoids	Melted and applied directly or mixed with natural wax for an ointment	Soothes inflammation, relieves itching and pain
	Fractures, bone pain, slipped discs, orthopedic issues, weak nerves	Heated fat massaged onto affected areas, sometimes infused with herbs like ginger or myrrh	Improves flexibility, reduces stiffness, strengthens nerves
	Skin inflammations, insect bites	Applied directly or mixed with clove oil	Reduces swelling, relieves itching
Cosmetic and Skin Care Uses	Hair treatment (dryness, hair loss, dandruff)	Used as a scalp oil or mixed with natural extracts (e.g., garlic, onion juice)	Strengthens hair, prevents breakage, promotes growth
	Facial masks, anti-aging creams	Blended with rose water, honey, and argan oil, applied as a mask	Hydrates skin, reduces wrinkles, enhances elasticity
	Skin moisturizing & whitening	Applied directly or combined with shea butter and vitamin E	Deep hydration, evens skin tone
	Cracked heels, lips, dry skin	Used as a balm, sometimes mixed with beeswax	Repairs cracked skin, restores elasticity
Culinary and Nutritional Uses	Traditional dishes (couscous, soups, stews, rice, meat dishes)	Cooked, fried, or roasted to enhance flavor	Adds rich texture, provides high-energy nutrition
	Bread stuffing, pastries	Melted and mixed with flour or dough	Improves texture, enhances taste
	Fat source for nomadic communities	Eaten raw, slightly melted, or mixed with dates for energy	Provides warmth, sustenance, and long-lasting energy
	Cooking & food preservation	Used for frying, making meat preserves, or as a storage fat	Acts as a natural preservative
General Uses	Body dryness (winter remedy)	Consumed orally or applied to skin	Prevents dehydration, nourishes skin
	Livestock fattening	Mixed with animal feed	Increases weight gain, provides energy

Author contributions

BA and IM conceptualized the study; BA and BZ conducted formal analysis; BA and BZ investigated the data; BA and IM prepared the original draft of the manuscript; ZB, AA, and TI contributed to reviewing and editing; TI, and AA supervised the study; BA, ZB, and IM curated the data; TI and AA critically revised the manuscript; and all authors contributed to manuscript validation.

Ethics approval

This research did not involve any direct interaction with animals or human subjects, and thus did not require ethical approval.

Access to research data

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of Generative AI in the writing process

Artificial intelligence tools were employed as auxiliary editing instruments. These tools primarily assisted with linguistic refinement, and improved logical connectivity, and academic writing style. Additionally, they aided in translation tasks and grammatical corrections. All scientific content, data interpretation, and conclusions presented in this study were independently developed by the authors. The use of AI was strictly limited to language and style improvements and did not contribute to the intellectual substance of the research. The authors assume full responsibility for all scientific inputs, analyses, and conclusions drawn in this work.

REFERENCES

Abrhaley, A., & Leta, S. (2018). Medicinal value of camel milk and meat. *Journal of Applied Animal Research, 46*(1), 552–558. https://doi.org/10.1080/09712119.2017.1357562

Algerian Ministry of Agriculture and Rural Development. (2023). Statistical service. Consulté le 20 juin 2025 sur https://fr.madr.gov.dz/?playlist=4a0503b&video=9ed131c

Ali, A., Baby, B., & Vijayan, R. (2019). From desert to medicine: a review of camel genomics and therapeutic products. *Frontiers in Genetics*, *10*. https://doi.org/10.3389/fgene.2019.00017

Behnam, M., Hollebeek, L., Clark, M., & Farabi, R. (2021). Exploring customer engagement in the product vs. service context. *Journal of Retailing and Consumer Services*, *60*, 102456. https://doi.org/10.1016/J.JRETCONSER.2021.102456

Chen, S., Lam, B., Hui, B., Ng, J., Mak, W., Guan, Y., Buchtel, E., *et al.*, (2016). Conceptualizing psychological processes in response to globalization: Components, antecedents, and consequences of global orientations. *Journal of Personality and Social Psychology, 110*(2), 302–331. https://doi.org/10.1037/a0039647

Dighikar, V., & Singh, S. (2021). Review on health impact of fast food on younger children. *Journal of Pharmaceutical Research International*, *33*(4B), 172–177. https://doi.org/10.9734/jpri/2021/v33i44b32662

El Khasmi, M., Moussahil, A., Mohamed, F., Iddar, A., & El Mzibri, M. (2023). Seasonal variation in the concentrations of vitamin D and macro-elements in the adipose tissue of the hump, blood serum, and muscle and liver tissues in the Arabian camel. *Journal of Camelid Science, 16*, 22–29.

Google Earth. (2025). Google map. https://satellites.pro/Google_plan/Ouargla_map

Guo, F., Si, R., He, J., Yuan, L., Hai, L., Ming, L., Yi, L., *et al*. (2019). Comprehensive transcriptome analysis of adipose tissue in the Bactrian camel reveals fore hump has more specific physiological functions in immune and endocrine systems. *Livestock Science*, *228*, 195–200. https://doi.org/10.1016/j.livsci.2019.09.003

Hadipour, A., Mohit, A., & Jahanian, R. (2014). Effect of dietary supplementation of camel hump fat on performance, carcass characteristics, antibody responses and blood metabolites in fattening lambs. *Small Ruminant Research*, *119*(1–3), 1–7. https://doi.org/10.1016/j.smallrumres.2013.12.029

Imelhayene, M., Adamou, A., & Becila, S. (2022). Economic importance of camels' contribution in the red meat production and Algerian food security. *Revue des Bioressources*, *12*(1), 2–12.

Jassim, S., Aldoori, A., AbdulMounam, M., Faraj, B., AbdulHameed, F., & Limoges, R. (2018). Photoprotection comprising oil derived from dromedary camel hump fat. *Annual Research & Review in Biology*, *27*(3), 1–11. https://doi.org/10.9734/arrb/2018/42132

Jassim, S. A., Aldoori, A. A., Mounam, M. A. A., Faraj, B. R., Hameed, F. F. A., & Limoges, R. G. (2020.) Photoprotection comprising oil derived from dromedary camel hump fat: an overview. In: *Current Research Trends in Biological Science* Vol. 2. (pp. 62–73). Book publisher international, India, United Kingdom. https://doi.org/10.9734/bpi/crtbs/v2

Jiang, J., Lau, P. W., Li, Y., Gao, D., Chen, L., Chen, M., Ma, Y., *et al*. (2022). Association of fast-food restaurants with overweight and obesity in school-aged children and adolescents: A systematic review and meta-analysis. *Obesity Reviews*, *24*(3). https://doi.org/10.1111/obr.13536

Li, Q., Yang, L., Li, R., Chen, G., Dong, J., Wu, L., Fu, Y., *et al*. (2023). Lipid analysis of meat from Bactrian camel (*Camelus bacterianus*), beef, and tails of fat-tailed sheep using UPLC-Q-TOF/MS based lipidomics. *Frontiers in Nutrition*, *10*. https://doi.org/10.3389/fnut.2023.1053116

Mashaly, M. M., Abdallah, M. R. S., Emara, M. M. T., & Elmossalami, M. K. (2020). Proximate chemical analysis, fatty acid profile, and microstructural characteristics of dromedary camel fats (hump, renal, and mesentery). *International Journal of Veterinary Science*, *9*, 279–284. https://www.ijvets.com/pdf-files/Volume-9-no-2-2020/279-284.pdf

Mohammed, H., Gene, G., Khalifa, A., Shawkat, R., Al-Khader, A., Zeng, Q., & Noaman, A. (2020). *Journal of Food Science and Technology*, *118*, 108714. https://doi.org/10.1016/j.lwt.2019.108714

Muzamil, M., Irfan, M., Shoaib, M., Ali, T., Saddiqa, A., Masood, A., Saeed, M. H., *et al*. (2024). A comprehensive review on therapeutic properties of camel milk. *Journal of Health and Rehabilitation Research*, *4*(1), 883–888. https://doi.org/10.61919/jhrr.v4i1.493

Nasser, B., Kebbaj, M. S., Moustaid, K., Bagri, A., Essamadi, A., & Latruffe, N. (2015). Lipid analysis of tissues from camel (*Camelus dromedaries*) reveals unique composition in fatty acids. *International Journal of Scientific & Engineering Research*, *6*(4), 270–276. https://www.ijser.org/researchpaper/Lipid-analysis-of-tissues-from-camel-Camelus-dromedaries.pdf

Nili, N. (2021). U.S. Patent No. 11,173,181. Washington, DC. U.S. Patent and Trademark Office.

Sahraoui, N., Errahmani, M. B., Dotreppe, O., Boudjenah, S., Babelhadj, B., Guetarni, D., & Hornick, J. (2015). Fatty acids profile of the dromedary hump fat in Algeria. *Journal of Camel Practice and Research*, *22*(1), 27. https://doi.org/10.5958/2277-8934.2015.00005.3

Sbihi, H. M., Nehdi, I. A., & Al-Resayes, S. I. (2013). Characterization of Hachi (Camelus dromedarius) fat extracted from the hump. *Food Chemistry*, *139*(1–4), 649–654. https://doi.org/10.1016/j.foodchem.2013.01.118

Senoussi A, H., Brahimi, Z., Kadri, S., & Faye, B. (2024). The dromedary in Algeria: An evolution at times of multifunctionality. *International Journal of Veterinary Science and Research*, *10*(2), 009–015. https://doi.org/10.17352/ijvsr.000144

Tharwat, M., Almundarij, T., Sadan, M., Khorshid, F., & Swelum, A. (2023). Is camel's urine friend or enemy? Review of its role in human health or diseases. *Open Veterinary Journal*, *13*(10), 1228. https://doi.org/10.5455/ovj.2023.v13.i10.1

Trade and Export Promotion Division of Ouargla Province. (2025). Introducing the Province. https://www.dcommerce-ouargla.dz/ar/exe2.php?art=wilaya

Résumé

Belfar A., Toumi I., Adamou A., Brahimi Z., Imelhayene M. Potentiel biofonctionnel et utilisation de la graisse de bosse de dromadaire : connaissances traditionnelles et perspectives scientifiques

***Contexte* :** La graisse de bosse de dromadaire est une ressource naturelle aux multiples usages traditionnels, médicinaux, cosmétiques et nutritionnels. Bien qu'elle occupe une place importante dans les pratiques ancestrales, son potentiel économique et son intégration dans les marchés modernes restent peu étudiés. Une meilleure compréhension des interactions entre savoirs traditionnels et commercialisation contemporaine est essentielle pour optimiser son utilisation. ***Objectif* :** Cette étude examine les pratiques traditionnelles, les dynamiques du marché et les influences socio-culturelles liées à l'utilisation de la graisse de bosse de dromadaire dans la région de Ouargla, en Algérie, entre 2019 et 2022. ***Méthodes* :** Une approche mixte a été adoptée, combinant l'analyse des données de production et des enquêtes menées auprès de 200 consommateurs et 80 bouchers/vendeurs. L'analyse en composantes multiples a permis d'évaluer les tendances du marché et les modes d'utilisation. ***Résultats* :** Les données révèlent une baisse significative de la production, passant de 332,3 tonnes en 2020 à 144,5 tonnes en 2022, ainsi que des fluctuations de prix entre 70 et 120 dinars algériens (0,48–0,83 EUR). Une disparité marquée entre connaissances théoriques et utilisation pratique a été observée selon les groupes démographiques : les jeunes hommes instruits possèdent un savoir approfondi mais en font un usage limité, tandis que les femmes âgées, bien que moins informées, utilisent régulièrement cette graisse. Celle-ci est employée à des fins médicinales (traitement des douleurs articulaires, affections respiratoires, etc.), cosmétiques (soins capillaires, anti-âge, etc.) et nutritionnelles. L'usage varie en fonction du niveau d'éducation et du contexte culturel, révélant un clivage générationnel dans les pratiques traditionnelles. ***Conclusions* :** Ces résultats illustrent l'interaction entre les savoirs ancestraux et les approches scientifiques modernes, mettant en lumière l'évolution des remèdes traditionnels dans la société contemporaine**.**

***Mots-clés* :** Dromadaire, corps gras animal, médicament traditionnel, demande du marché, comportement du consommateur, Algérie

Resumen

Belfar A., Toumi I., Adamou A., Brahimi Z., Imelhayene M. Potencial biofuncional y uso de la grasa de joroba de dromedario: conocimientos tradicionales y perspectivas científicas

***Contexto*:** La grasa de joroba de dromedario es un recurso natural con múltiples usos tradicionales, medicinales, cosméticos y nutricionales. Aunque ocupa un lugar importante en las prácticas ancestrales, su potencial económico y su integración en los mercados modernos aún están poco estudiados. Sería esencial una mejor comprensión de las interacciones entre saberes tradicionales y comercialización contemporánea para optimizar su uso. ***Objetivo*:** Este estudio examina las prácticas tradicionales, las dinámicas del mercado y las influencias socioculturales relacionadas con el uso de la grasa de joroba de dromedario en la región de Uargla, en Argelia, entre 2019 y 2022. ***Métodos*:** Se adoptó un planteamiento mixto, que combina el análisis de los datos de producción y de las encuestas realizadas a unos 200 consumidores y 80 carniceros/vendedores. El análisis de componentes múltiples permitió evaluar las tendencias del mercado y las formas de uso. ***Resultados*:** Los datos revelan una baja significativa de la producción, pasando de 332,3 toneladas en 2020 a 144,5 toneladas en 2022, así como fluctuaciones de precio entre 70 y 120 dinares argelinos (0,48–0,83 EUR). Se observó una disparidad marcada entre conocimiento teórico y utilización práctica según los grupos demográficos: los hombres jóvenes instruidos poseen un conocimiento profundo, pero utilizan esta grasa de forma limitada, mientras que las mujeres de más edad, aunque menos informadas, la utilizan habitualmente. Se emplea con fines medicinales (tratamiento de dolores articulares, afecciones respiratorias, etc.), cosméticos (tratamientos capilares, antiedad, etc.) y nutricionales. El uso varía en función del nivel educativo y del contexto cultural, y revela una brecha generacional en las prácticas tradicionales. ***Conclusiones*:** Estos resultados ilustran la interacción entre los saberes ancestrales y los enfoques científicos modernos, sacando a la luz la evolución de los remedios tradicionales en la sociedad contemporánea.

Palabras clave: Dromedario, grasa animal, medicamento tradicional, demanda del mercado, comportamiento del consumidor, Argelia