Re-Building Sudan
AFTER THE WAR

AGRICULTURE, ENVIRONMENT AND NATURAL RESOURCES

OPEN ACCESS

DOI: 10.47556/B.SUDAN2025.19

CHAPTER 19

LITERATURE REVIEW

Sustainable Traceability for Production and Marketing of Camel (Camelus dromedarius) for Promotion and Rebuilding Sudan after War

Professor Ibtisam E. M. El Zubeir
Institute for Studies and Promotion of Animal Exports, University of Khartoum, Sudan
Email: Ibtisamelzubeir17@gmail.com
ORCID: 0000-0001-8173-7693

ABSTRACT

PURPOSE: This chapter describes the challenges facing camel production and marketing, with some recommendations to restore camels to Sudan.

DESIGN/APPROACH: The design depends on previous field visits, official data and publications.

FINDINGS: Camels survive well in harsh environments. Sudan was the second richest country in owning and exporting live animals worldwide until 2019. In Sudan, the camel has important socio-economical roles among the traditional herders. Uses include milk, meat, wool, hide, racing, traction and tourism. However, the processing of camel products is limited.

ORIGINALITY/VALUE: Implementing some interventions will improve the husbandry practices and solve the constraints facing the commercialisation of camels. The application of animal identification will conserve national herds' genetic resources, while traceability is important for upgrading products' quality and facilitating international trade.

PRACTICAL IMPLICATIONS: Enhancing camel production and marketing, promoting lifestyle of producers and traders, promoting exports and upgrading product quality, therefore conserving national herds' identity and economic growth.

KEYWORDS: *Camelus dromedarius; Sudan; Nomads; Production Systems; Constraints; Processing; Interventions; Traceability; Export*

CITATION: El Zubeir, I.E.M. (2025): Sustainable Traceability for Production and Marketing of Camel (Camelus dromedarius) for Promotion and Rebuilding Sudan after War. In Ahmed, A. (Ed.): *Re-Building Sudan from War to Sustainable Development*, Vol 1, pp. 313-324

RECEIVED: 14 May 2025 / **REVISED:** 24 July 2025 / **ACCEPTED:** 30 July 2025 / **PUBLISHED:** 1 December 2025

COPYRIGHT: © 2025 by all the authors of the chapter above. The chapter is published as an open access chapter by WASD under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/)

INTRODUCTION

According to Kishore *et al.* (2024), the Camelidae family includes the Old World camelids, represented by the dromedary (one-humped) camel (*Camelus dromedarius*) and Bactrian (two-humped) camel (*Camelus bactrianus*), as well as the New World camelids, also known as South American camelids that consist of Llama (*Lama glama*), Alpaca (*Lama pacos*), Guanaco (*Lama guanicoe*), and Vicuña (*Vicugna vicugna*). Camelids play an important role in the preservation of ecosystems, biodiversity, food security, economic growth, adaptation to climate change, and cultural and social aspects (Gagaoua *et al.*, 2022; Abu-Seida *et al.*, 2024). Therefore, the United Nations (UN) named 2024 the International Year of Camelids (IYC) (Abu-Seida *et al.*, 2024). Camelids play an important role in achieving the UN's Sustainable Development Goals (SDGs) of hunger reduction, severe poverty eradication, women's empowerment, and sustainable use of land ecosystems (Gagaoua *et al.*, 2022). The IYC presented a unique opportunity to raise awareness of public and politicians' understanding of camelids' role in climate change resistance, particularly in highland, desert, and semi-arid areas (FAO, 2024).

Camels store fat for energy in their humps (the dromedaries have one hump and Bactrians have two humps) and live in herds with a dominant male, females, and offspring (Soliman, 2015). Camels thrive in locations other livestock animals cannot tolerate, and provide milk, meat, and wool, transportation and organic fertiliser for the camels' communities (Gagaoua *et al.*, 2022).

The general contribution of the livestock sector to Sudan's exports and foreign exchange earnings is substantial as it provides critical support to the national economy. Therefore, if the challenges and leveraging opportunities of livestock sectors are solved, the performance of the livestock exports can be enhanced and sustained economic benefits and improved livelihoods for the population are ensured (Alfadul *et al.*, 2024).

Camel History

Salman (2002) stated that camels probably entered Sudan through the Egyptian route since ancient times, the North West African route during the 4th to 6th centuries and, more recently, the Red Sea route. Meroe was the southern capital of the Napata/Meroitic Kingdom in Sudan (c. 800BC to c. 350AD) and there is strong belief that dromedary camels (one humped camel) entered Meroe from Egypt, following either the River Nile or through the desert 2980-2475BC (Addison, 1934). There is a Meroe plaque showing the existence of camels during that time, the oldest evidence being a bronze figure of a camel with a saddle dating back to 25-15BC (Addison, 1934; Mukasa-Mugerwa, 1982).

Many of the oil-rich Arab states are spending millions to conserve camels by organising racing events, beauty contests and promoting camel milk to conserve their cultural and religious heritage (Köhler-Rollefson, 2014). The Prophet Muhammad (peace be upon him) rode on a camel during his journey from Mecca to Yathrib, currently Medina (Alladin, 2005).

© 2025 World Association for Sustainable Development (WASD)

Camel Adaptation

Kishore *et al.* (2024) cited that camelids have specialised anatomical, physiological, and behavioural adaptations that enable them to thrive in areas of challenging environments (arid deserts to the elevated Andean highlands). Camels have adaptations for the desert, having thick lips to eat prickly shrubs, long eyelashes and the ability to close their nostrils to keep out sand (Soliman, 2015). Camels are found to have survived and adapted to the arid and semi-arid regions, producing acceptable amounts of milk to sustain their owners' lives in the harsh environment (Bekele *et al.*, 2002; Farah *et al.*, 2007; Shuiep *et al.*, 2014b; Dowelmadina *et al.*, 2015). In addition, in East Africa, ethnic tribal groups are moving away from cattle to camels as the latter is more resilient to droughts and the vagaries of climate change (Köhler-Rollefson, 2014).

Camel Population

There are two species in the Genus Camelus: the Bactrian camel (*Camelus bactrianus*), found in both wild and domesticated forms, and the dromedary camel (*Camelus dromedarius*), or Arabian camel, which is now completely domesticated (Kishore *et al.*, 2024). They are also known as Old World camelids or large camelids (Bornstein, 2021).

The bulk of camel populations in Sudan are found mainly in the arid and semi-arid parts of the country north of latitude 13^{o}N, the camel belt, that extends from 12^{o}N to 16^{o}N (Elamin, 1979).

Sudan has the second largest number of camels in Africa. According to livestock estimates, the camel population in Sudan was about 4,850,000 head distributed around the country (MARF, 2017). Table 1 shows that the annual camel population estimate for Sudan in 2015 was 4.81 million with a slight increasing trend to 5.02 million in 2022 (Alfadul *et al.*, 2024). It also shows that the inconsistencies might be due to the methods of estimates as well a lack of record-keeping practices. Therefore, a real livestock census instead of estimates should be performed based on proper animal identification, registration and traceability of Sudan camels and other livestock. This will be a critical solution for solving the problems that extend back several years, conserving the identity of Sudan livestock wealth. This is especially necessary because of the shift in camel ownership to third position during 2019-2025, before which Sudan occupied the second position worldwide. The camel shows important socio-economical roles among the traditional herders.

© 2025 World Association for Sustainable Development (WASD)

Table 1: Camel Population Estimates for Sudan 2015-2022

Years	*Average camel population*
2015	4.81
2016	4.83
2017	4.85-4.86
2018	4.87-4.88
2019	4.90
2020	4.92-4.95
2021	4.98
2022	5.02

Source: Adopted from Alfadul *et al.* (2024)

Camel Production Systems

The four camel management systems practiced in Sudan include the predominant traditional nomadic system, the transhumance or semi-nomadic system, sedentary or semi-sedentary system, and the intensive system (Dowelmadina *et al.*, 2015). The transhumance production system is characterised by seasonal movement of the herders to make use of free-range pasture (Mohammed and El Zubeir, 2023). With conventional agriculture and livestock production, this system is becoming virtually impossible due to the increasing effects of climate change. However, camels with their multi-dimensional contributions and ability to withstand climate change will emerge as the key to sustainability in the coming years (Kishore *et al.*, 2024).

- Camel Rearing

Most of the camel herders in Sudan were found to practice a variety of movement patterns that range from contentious mobility to short-distance movement. Sudan is the second richest country in owning camels worldwide; however a shift was recorded to third position during 2019-2025. The camel shows important socio-economical roles among the traditional herders, and camel pastoralists are always moving over large areas in search of food and water for their camels (Musa *et al.*, 2006). Women's participation in camel husbandry is low, due mainly to the customs and beliefs prevalent in Bedouin societies that all women must be far from men; a separate reception area is available for guests (Osman *et al.*, 2023).

- Uses of Camels

Camelids are an intertwined part of cultural heritage and emerge as vital economic contributors for local communities by providing invaluable resources such as milk, fibre and meat, thus playing a positive role in the economic well-being of their owners (Kishore *et al.*, 2024). The contribution of camels is mainly in transport, racing and in offering milk and meat (Dowelmadina *et al.*, 2015; Gebreyohanes and Assen, 2017; Yousof and El Zubeir, 2019). Also, camels are vital to daily life for the people living in the desert, as a source of food, means of transportation and as medicines; they

© 2025 World Association for Sustainable Development (WASD)

have been used against diverse ailments since ancient times (Gader and Alhaider, 2016).

Because of its outstanding performance in the arid and semi-arid areas of Sudan where browsing pastures and water are limited, pastoralists rely mainly on camels for their livelihood. In some of these areas, camels are mainly kept for milk production (Amasaib *et al.*, 2013). In pastoral societies, camel milk is traditionally consumed predominantly in the form of fermented or fresh (Farah *et al.*, 2007; Hassan *et al.*, 2008; Suliman and El Zubeir, 2014). However, camels have dual purposes for milk and meat; camel meat consumption is niche, being only 8% in Sudan (Omer, 2011). Meat from camels is a typical by-product as it is usually obtained from older animals that either produce little or no milk or are unable to serve other functions (Wilson, 2018).

- Camel Milk

Camel milk is of value for nomads as food resources in Sudan that can contribute to nutrition and income for pastoralists, who consumed more camel milk compared to the urban settlers. There is a current trend for increasing the number of camels in the urban population, mainly due to its medicinal benefits (El Zubeir and Ehsan, 2006; Shuiep *et al.*, 2014b; Dowelmadina *et al.*, 2015; Yadav *et al.*, 2015; Mohamed-Elhassan and El Zubeir, 2024). Variations in the composition of camel milk were reported as being due to different locations, management systems that are influenced by the availability of feed and water, and lactation stages (Dowelmadina *et al.*, 2014; Mohamed-Elhassan and El Zubeir, 2024). Figure 1 illustrates the major chemical compositional content. Camel milk is called white gold of the desert; it is more or less similar to human milk compared to other ruminant milk as it contains low cholesterol and sugar and high minerals (sodium, potassium, iron, copper, zinc, magnesium, vitamin C, lactoferrin, lactoperoxidase, immunoglobulins and lysozyme) (Yadav *et al.*, 2015).

© 2025 World Association for Sustainable Development (WASD)

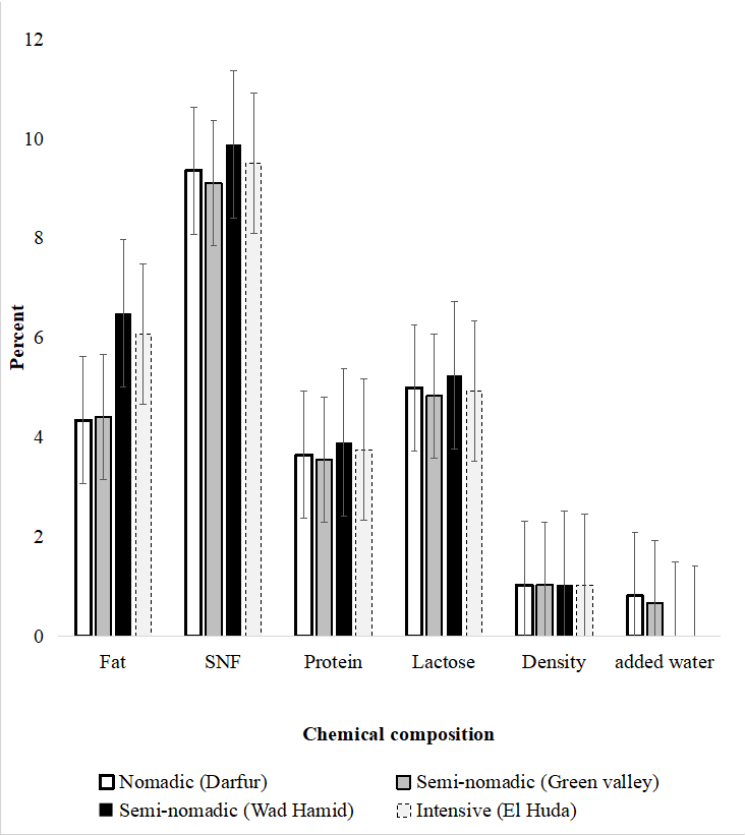

Figure 1: Effect of Production Systems on the Chemical Composition of Camel Milk
Source: Adopted from Mohamed-Elhassan and El Zubeir, 2024

Camel Milk Processing and Products

The nomadic camel herders utilising the extensive production system in Sudan depend mainly on fermented milk, locally known as Gariss, as their main staple food for several months during the year (Osman *et al.*, 2024).

Camel milk is consumed mainly in fermented form (Gariss) by camel herders in North Darfur and is offered to the majority of the local population and visiting guests (Osman *et al.*, 2023). Fermented products of camel milk vary according to the method of processing (Lore *et al.*, 2005; Hassan *et al.*, 2008; Suliman and El Zubeir, 2014). The conditions and methods for the preparation of Gariss are variable using different containers and additives. The best containers to prepare and store fermented camel milk are the traditional *Siin* and *Bokhsa* (Osman *et al.*, 2023). Traditionally, fermented camel milk is allowed to ferment naturally without prior heat treatment and without the addition of starter cultures (Hassan *et al.*, 2008; Suliman and El Zubeir, 2014). However, among

© 2025 World Association for Sustainable Development (WASD)

camel herders, some women are responsible for processing and marketing fermented milk, although they are rarely allowed to participate in milking. All the traditions laid down by the ancestors are honoured for the sustainable livelihood (El Zubeir and Shuiep, 2019).

- Constraints

When climatic conditions become harsh during the dry season, camel herders settle near water sources, mainly around the cities or cultivated areas to make use of crops residues (El Zubeir and Shuiep, 2019). However, during their continuous transhumance, camels are affected by many production limiting factors such as diseases, range and pasture limitations, water scarcity, high calf mortality and security problems (Abbas and Omer, 2005; Amasaib *et al.*, 2013; El Zubeir and Ehsan, 2006; Ishag and Ahmed, 2011; Musa *et al.*, 2006).

The multi-disciplinary participatory and collaborative research and developmental projects that are proposed in this chapter will help all stakeholders throughout the camel production and marketing chain, offering compacting with climate change, securing the food (meat and milk) and promoting the lifestyle among the camel producers and traders. Meanwhile, at the national level, the benefits will include increasing and promoting exports (live animals and products), upgrading the safety and quality of the camel products, and new non-traditional and international markets. This can be achieved through the identification, registration and traceability of Sudan's camels and other livestock. The intermediate technology interventions and application of proper animal identification and traceability will conserve and restore the national herd's identity and thus national economic growth.

- Camel Marketing and Trade

Achieving sustainability from camelids for a secure future necessitates a collaborative approach involving all system participants, ranging from local communities and the general public to government and research entities (Kishore *et al.*, 2024).

Camel herders in most of the traditional systems in Sudan do not practice or accept the sale of camel milk (Musa *et al.*, 2006; Shuiep and El Zubeir, 2012; El Zubeir and Shuiep, 2019) as there are no well-established camel dairy farms (Shuiep and El Zubeir, 2008; Yousof and El Zubeir, 2019). However, there is a recent trend towards the initiation of commercial camel dairy farms in the semi-intensive camel production system in Khartoum State and other big towns of the country (Shuiep and El Zubeir, 2012; Yousof and El Zubeir, 2019). Camels can browse on low productive pastures on which the production of milk is possible and economically profitable (Dirar, 1993). This seems to be a suitable alternative for supplying urban areas with camel milk where there is a growing market demand, thus raising the monetary value of camel rearing (Shuiep *et al.*, 2014a).

© 2025 World Association for Sustainable Development (WASD)

It is of benefit that camel milk and its fermented products are offered for urban consumers in order to make use of the advantage of the value of camel milk as an organic and functional food (Osman *et al.*, 2023).

The collaborative research and developmental projects that are proposed in this chapter use some intermediate technology interventions that will promote and upgrade camel products and the overall national economic growth.

- Exportation of Camels

The numbers and value of live camels exports during 2016 to 2020 (Table 2), could be improved at the national level by increasing and promoting exports via moving from exporting live animals to products. This could be achieved via upgrading the safety and quality of camel products by application of identification, registration and traceability programmes; this should be coupled with seeking new, non-traditional and international markets. Among the benefits of traceability programmes are conservation, restoring the national herd's identity and the increasing net gain from such valuable animals and products.

Table 2: Contribution of Live Camel Exports to Sudan 2016-2020

Years	*Camel numbers*	*Values (US$1,000)*
2016	25,464	28,989
2017	256,445	302,025
2018	192,220	216,843
2019	110,739	121,847
2020	127,769	137,597

Source: Adopted from Alfadul *et al.* (2024).

The current recommended participatory and collaborative developmental research project will help all stakeholders dealing with camel production and marketing chains to reduce the negative effect of climate change, secure their needs from milk and meat as well as promoting their lifestyle. However, waste in the production of hides and skins is significant due to poor production practices, including in the preparation, conservation, and processing of the hides and skins (Alfadul *et al.*, 2024). To maximise returns, the hides, skins and leather sectors in Sudan need significant upgrading, especially in value addition (Wilson, 2018).

CONCLUSIONS

© 2025 World Association for Sustainable Development (WASD)

Camels are very valuable animals and contribute to food security, socio-economic and national wealth in Sudan. However, this study recommends proper traceability programmes to conserve national herds. Also, extension services, including veterinary supervision, are needed to increase the awareness of camel breeders and herdsmen on the best camel rearing practices via accurate methods of making and preserving camel products. Providing the proper means of processing, marketing and transportation via demonstration, co-operation and creation of markets and consumption to take advantage of the value of camel milk and meat as organic and functional food should be addressed in order to promote its contribution to food security and sustainable development. This will help to achieve the UN 2030 Sustainable Development Goals.

REFERENCES

Abbas, B. and Omer, O.H. (2005): Review of infectious diseases of the camel. *Veterinary Bulletin*, Vol. 75, No. 8, pp.1-16. Available at: https://doi.org/10.1079/cabireviews20053143609

Abu-Seida, A.M., Hassan, M.H., Abdulkarim, A. and Hassan, E.A. (2024): Recent progress in camel research. *Open Veterinary Journal*, Vol. 14, No. 11, p.2877. Available at: https://doi.org/10.5455/OVJ.2024.v14.i11.16

Addison, F. (1934): *A Short Guide to the Museum of Antiquities.*, Gordon College, Khartoum. Sudan Department of Antiquities. Gordon Memorial College.

Alfadul, H., Siddig, K., Ahmed, M., Abushama, H. and Kirui, O. (2024): *Sustainable livestock development in Sudan: Challenges, opportunities, and policy priorities*. Sudan Strategy Support Program Working Paper 19. Washington, DC: International Food Policy Research Institute. Available at: https://hdl.handle.net/10568/151697

Alladin, B. (2005): *Story of Mohammad the Prophet*. Hemkunt Press.

Amasaib, E.O., Mohamed, H.E., Ishag, I.A. and El Zubeir, I.E.M. (2013): The status of camel milk production in Sudan. *International Conference on Sustainability of Camel Population and Production* (pp.172-177), 17-20 February 2013. Faculty of Agriculture and Food Science, King Faisal University, Hafuf Al-Ahssa, Saudi Arabia.

Bekele, T., Zeleke, M. and Baars, R.M.T. (2002): Milk production performance of the one humped camel (*Camelus dromedarius*) under pastoral management in semi-arid eastern Ethiopia. *Livestock Production Sciences*, Vol. 76, Nos 1-2, pp.37-44. Available at: https://doi.org/10.1016/S0301-6226(01)00333-5

Bornstein, S. (2021): Evolution, distribution, and economic importance of the camels. In Khalafalla, A.I. and Hussein, M.F. (Eds): *Infectious diseases of Dromedary Camels: A Concise Guide* (pp.1-19). Springer International Publishing, Cham. Available at: https://doi.org/10.1007/978-3-030-79389-0_1

Dirar, H.A. (1993): *The Indigenous Fermented Food of the Sudan: A study in African Food and Nutrition*. CAB International, England.

Dowelmadina, I.M.M., El Zubeir, I.E.M., Arabi, O.H.M.H. and Abaker, A.D. (2015): Performance of she camels under traditional nomadic and semi-intensive management in Sudan. *Livestock Research for Rural Development*, Vol. 27, Article 107. Available at: http://lrrd.cipav.org.co/lrrd27/6/dowe27107.htm

© 2025 World Association for Sustainable Development (WASD)

Dowelmadina, I.M.M., El Zubeir, I.E.M., Salim, A.D.A. and Arabi, O.H.M.H. (2014): Influence of some factors on composition of dromedary camel milk in Sudan. *Global Journal of Animal Scientific Research*, Vol. 2, No. 2, pp.120-126. Available at: http://archives.gjasr.com/index.php/GJASR/article/view/34/149

El Zubeir, I.E.M. and Ehsan, M.N. (2006): Studies on some camel management practices and constraints in pre-urban areas of Khartoum State, Sudan. *International Journal of Dairy Science*, Vol. 1, No. 2, pp.104-112. Available at: https://doi.org/10.3923/ijds.2006.104.112

El Zubeir, I.E.M. and Shuiep, T.S. (2019): Some social and cultural traditions of Sudanese nomadic tribes in rearing camels. In: *Third International Selçuk-Ephesus Symposium on Culture of Camel Dealing and Camel Wrestling* (pp.131-146). 17-19 January 2019, Selçuk, Izmir, Turkey.

Elamin, F.M. (1979): The Dromedary of the Sudan. Paper presented at *The Camelid an all-purpose animal. Proceedings of the Khartoum Workshop on Camels*. Motala, Grafediska, Sweden.

Farah, Z., Mollet, M., Younan, M. and Dahir, R. (2007): Camel dairy in Somalia: Limiting factors and development potential. *Livestock Science*, Vol. 110, Nos 1-2, pp.187-191. Available at: https://doi.org/10.1016/j.livsci.2006.12.010

Food and Agriculture Organization of the United Nations (FAO) (2024): *Heroes of deserts and highlands: Nourishing people and culture*. FAO, Rome, Italy. *Available at:* https://www.fao.org/camelids-2024/about/en.

Gader, A.G.M.A. and Alhaider, A.A. (2016): The unique medicinal properties of camel products: A review of the scientific evidence. *Journal of Taibah University Medical Sciences*, Vol. 11, No. 2, pp.98-103. Available at: https://doi.org/10.1016/j.jtumed.2015.12.007

Gagaoua, M., Dib, A.L. and Bererhi, E.H. (2022): Recent advances in dromedary camels and their products. *Animals*, Vol. 12, No. 2, p.162. Available at: https://doi.org/10.3390/ani12020162

Gebreyohanes, M.G. and Assen, A.M. (2017): Adaptation mechanisms of camels (*Camelus dromedarius*) for desert environment: A review. *Journal of Veterinary Science and Technology*, Vol. 8, No. 6, pp.1-5. Available at: https://doi.org/10.4172/2157-7579.1000486

Hassan, R.A., El Zubeir, I.M.E. and Babiker, S.A. (2008): Chemical and microbial measurements of fermented camel milk "Gariss" from transhumance and nomadic herds in Sudan. *Australian Journal of Basic and Applied Sciences*, Vol. 2, No. 4, pp.800-804. Available at: http://insinet.net/ajbas/2008/800-804.pdf

Ishag, I.A. and Ahmed, M.K.A. (2011): Characterization of production system of Sudanese camel breeds. *Livestock Research for Rural Development*, Vol. 23, No. 3, p.56. Available at: http://www.lrrd.org/lrrd23/3/isha23056.htm

Kishore, A., Pal, B. and Sarkar, P. (2024): Camelids for sustainability: a socio-economic perspective. *Asian Journal of Environment and Ecology*, Vol. 23, No. 1, pp.53-72. Available at: https://doi.org/10.9734/AJEE/2024/v23i1521

Köhler-Rollefson, I. (2014): *Camel karma: Twenty years among India's camel nomads*. Westland. Publisher Speaking Tiger Book.

Lore, T.A., Mbugua, S.K. and Wangoh, J. (2005): Enumeration and identification of microflora in suusac, a Kenyan traditional fermented camel milk product. *LWT-Food Science and Technology*, Vol. 38, No. 2, pp.125-130. Available at: http://erepository.uonbi.ac.ke:8080/xmlui/handle/123456789/10887

© 2025 World Association for Sustainable Development (WASD)

Ministry of Animal Resource and Fisheries (MARF) (2017): Ministry of Animal Resource and Fisheries, Department of Statistics and Information, Khartoum, Sudan.

Mohamed-Elhassan, S.M.B. and El Zubeir, I.E.M. (2024): Factors associated with chemical composition of camel milk from different production systems in Sudan. *East African Scholars Journal of Agriculture and Life Sciences*, Vol. 7, pp.60-69. Available at: https://doi.org/10.36349/easjals.2024.v07i04.001

Mohammed, R.H.A. and El Zubeir, I.E.M. (2023): Seasonal variations of chemical composition and microbiological quality of camels milk in transhumance nomadic production system in Shandi area, Northern Sudan. *East African Scholars Journal of Agriculture and Life Sciences*, Vol. 6, No. 9, pp.157-163. Available at: https://doi.org/10.36349/easjals.2023.v06i09.001

Mukasa-Mugerwa, E. (1981): *The camel (Camelus dromedarius): A bibliographical review.* Published by International Livestock Central for Africa (ILCA), ILCA Monograph. 5. Available at: https://cabidigitallibrary.org/doi/full/10.5555/19830483657

Musa, H.H., Shuiep, E.S. and El Zubeir, I.E.M. (2006): Camel husbandry among pastoralists in Darfur, western Sudan. *Nomadic Peoples*, Vol. 10, No. 1, pp.101-105. Available at: https://doi.org/10.3167/082279406781020428

Omer, A.M. (2011): Agriculture policy in Sudan. *Agricultural Science Research Journal*, Vol. 1, No. 1, pp. 1-29. Available at: https://land.igad.int/index.php/documents-1/countries/sudan/rural-development-6/1138-agriculture-policy-in-sudan/file

Osman, H.I., Shuiep, E.T.S. and El Zubeir, I.E. (2024): Chemical composition of Gariss produced from milk of camels with different watering intervals using some traditional containers in Al-Koma Locality, North Darfur State, Sudan. *Journal of Ethnic Foods*, Vol. 11, No. 1, p.10. Available at: https://doi.org/10.1186/s42779-023-00217-z

Osman, H.I.I., Dowelmadina, I.M.M., Sabeel, S., Arabi, O.H.M.H. and El Zubeir, I.E.M. (2023): Traditional practices of production and consumption of the fermented camel milk "Gariss" in Al-Koma Locality, North Darfur State, Sudan. *Journal of Current Trends in Food Safety, Nutrition & Technology*, Vol. 3, No. 1, pp.1-10.

Salman M. (2002): *Some husbandry aspects of camel in the Buttana area in Eastern Sudan*. MSc Thesis, University of Khartoum, Sudan.

Shuiep, E.S. and El Zubeir, I.E.M. (2008): Current practices and future prospective in pre-urban camel farming in Khartoum State, Sudan. *Competition for Resources in a Changing World: New Drive for Rural Development*. Tropentag, 7-9 October 2008, Hohenheim, Germany. Available at: https://doi.org/10.13140/2.1.2868.1921

Shuiep, E.S. and El Zubeir, I.E.M. (2012): The semi intensive camel farming a newly adopted system in Sudan: description and role in food security for herders' communities. In *Proceedings of the 3rd Conference of the International Society of Camelid Research and Development* (pp.167-168). Available at:

 © 2025 World Association for Sustainable Development (WASD)

https://www.researchgate.net/publication/268447542

Shuiep, E.S., El Zubeir, I.E.M. and Yousif, I.A. (2014a): Socioeconomic aspects of rearing camels under two production systems in Sudan. *Livestock Research for Rural Development*, Vol. 26, p.11. Available at: www.lrrd.org/lrrd26/11/shui26208.html 6

Shuiep, E.S., El Zubeir, I.E.M. and Yousif, I.A. (2014b): Compositional quality of camel milk and some husbandry practices associated with camel milk production in two production systems in Sudan. *Sudan Journal of Agricultural and Veterinary Sciences (SJAVS)*, Vol. 15, pp.10-18.

Soliman, M.K. (2015): Functional anatomical adaptations of dromedary (*Camelus dromedarius*) and ecological evolutionary impacts in KSA. In: *International Conference on Plant, Marine and Environmental Sciences (PMES-2015)* (pp.19-22), Kuala Lumpur, Malaysia.

Suliman, E.S. and El Zubeir, I.E. (2014): A Survey of the Processing and Chemical Composition of Gariss Produced by Nomadic Camel Women Herders in AlGaderif State, Sudan. *Jordan Journal of Biological Sciences*, Vol. 7, No. 2, pp.95-100. Available at: https://doi.org/10.12816/0008221

Wilson, R.T. (2018): Livestock in the Republic of the Sudan: Policies, production, problems and possibilities. *Animal Husbandry, Dairy and Veterinary Science*, Vol. 2, No. 3, pp.1-12. Available at: https://doi.org/10.15761/AHDVS.1000142

Yadav, A.K., Kumar, R., Priyadarshini, L. and Singh, J. (2015): Composition and medicinal properties of camel milk: A Review. *Asian Journal of Dairy & Food Research*, Vol. 34, No. 2, pp.83-91. Available at: https://doi.org/10.5958/0976-0563.2015.00018.4

Yousof, S.S.M. and El Zubeir, I.E.M. (2019): Dealing with Camels Marketing in Sudan. *Third International SelçukEphesus Symposium on Culture of Camel Dealing and Camel Wrestling* (pp.217-228). 17-19 January 2019, Selçuk, Izmir, Turkey.

© 2025 World Association for Sustainable Development (WASD)

BIOGRAPHY

Professor Ibtisam E.M. El Zubeir is a veterinarian with a PhD in Animal Production (Dairy Production). She has participated in much funded research, and has written over 170 papers and attended 56 conferences. Dr El Zubeir is currently a Full Professor and the Director for the Institute of Studies & Promotion of Animal Exports, Khartoum University, and participates in many international professional activities.

© 2025 World Association for Sustainable Development (WASD)