Global Scientific JOURNALS

GSJ: Volume 8, Issue 6, June 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

TECHNOLOGY ADVANCEMENT IN DAIRY CAMEL: A REVIEW

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KeyWords
Keywords: Breed characterization; Camelus dromedaries; Camel production; Dairy camel; Ethiopia; Technology advancement

ABSTRACT

This comprehensive review intended to identify current technology advancement in dairy camel production. This review was uncovered that numbers of countries were hosted camel has been progressed on technology advancement in camel genetics, breeding techniques; production and reproduction technology; milk and milk processing; meat production, and other benefits of the camel. However, in Ethiopia, lack of adequate information that indicates those technologies have been tested. On the contrary, the camel was not even got attention from policymakers and other concerned stakeholders in comparison with other domestic animals (cattle, goat, sheep, and equines, etc.). Camel is now becoming the key animal among domestic species where different countries were understood the multipurpose of camel and it is products. The high demand for camel across the world population could be challenges for the producers to equal response for boomed demand for the camels' products in terms of quality and quantity. It has been noted that transferring existing camel production technologies could be one option to reach the increased demand particularly camels are natural very slow reproduction performance because of the seasonal breeding calendar and natural mating habits. So it could be a priority for Ethiopia to adopt those technologies to improve the production and productivity of camels that put the country in third place among African countries. This review was noted that Ethiopia should learn or upscale technology advancement of camels in the production system, milk processing, reproduction, breeding, and genetics. Now it is the right time to think at policy level on camel production and looks for the further fund to conduct research on camel technology advancements and disseminate the findings could be an assignment for researcher and academicians. Therefore, it is much more important to undertake further investigations on the findings to supplement this conclusion

1. Introduction

The camels are completely having a place with the group of Camelidae involved two principle types (huge and little camelids). The little camelids that started from North America incorporate two local species (lama and alpaca) and two wild species (guanaco in class lama, and vicuna in variety vicugna) while the enormous camelids are partitioned into one-bumped camel and two-bumped camel [1]; [2]. Consequently, the camels live in the tremendous peaceful regions in Africa and Asia is having a place with the variety Camelus, which Camelus dromedaries are primarily live and versatile limits in the desert regions and Camelus bactrianus are lean toward living in the cooler territories [3]. As indicated by [2] for quite a while, the one-bumped camel has been considered as desert delivers in Africa. It was accepted that the developmental history of dromedary and Bactrian camels were traces back to around 40 million years ago [4]; [5].

These animals have aided the nomadic ancient civilizations for different purposes such as transportation and played significant roles in the ancient war [6]. The camels are a good source of milk, meat, and other purposes such as transportation and cash in times of need for large people living in the arid and semi-arid [7].

The estimated camel population in the world was about 23 million which 90% were one-humped camel [8]. However, recent data shows camel distributions and a large number of the one-humped camel is found geographically in North, West and East parts of Africa and the Middle East and Western Asia [9]

The distributions and numbers are not documented like another domestic animal this was believed that due to the production system has been dominantly managed in the pastoral system where large mobility and low attentions by respective countries [4]. Moreover, the existing knowledge on functions of camels for the large populations and roles in the country's economy; breed types, management practices, production, use, and different recent technologies were inadequate as compared with other domestic animals [10]. Nowadays, researchers have been using different techniques for a better understanding of this production like breed characterizations, economic importance, production, and product performance [11]. However, because of inadequate information on a camel, the breeds' characterization was not clearly distinguished in those regions specifically in Africa [12]. As indicated above this animal has been managed in nomadic, sedentary, and transhumance systems which highly depend on environmental variability. due to lack of advanced research and inadequate information regarding small species of camels particularly the Lama and Vicugna and this review itself comparative with camel found in Ethiopia, those two camels (Lama and Vicugna) were not discussed under this review because they are not found in Ethiopia and Camelus bactrianus are also not found in Ethiopia some technology advancement has been reported were also included under this review for better understanding of the situation.

The current review was technology advancement in camel production. Nevertheless, the camel breed types found in Ethiopia are only Camels with single-humped type, or dromedary (Camelus dromedaries) therefore, much of the discussions were concentrated on the one-humped camel. Hence, this review was envisaged on existing knowledge regarding Advancement in camel genetics and breeding techniques; advancements in Camel production technologies; milk and milk production technologies; meat and meat production technologies; technology advancement on other benefits of a camel; its challenge and opportunities in camel production and finally conclusions

Therefore, the aim was to identify current knowledge on technology advancement in dairy Camel Production and indicate the future considerations for camel production in Ethiopia.

Overviews of Camel Population in the World and Ethiopia

The estimated camel population in the world is about 23 million which 90% are one-humped camel [8]. However, distributions and numbers are not documented like other domestic animals. Though, it is believed that due to the production system which dominantly extensive system where large mobility and poor recording [4]. As global camel population could be categorized in five descriptive situations of the countries context; these are countries with regularly camel population growing, mainly in the Horn of Africa and near east; Countries with fresh but important progress of their camel population mainly West Africa and Arab peninsula; the countries with a stable population (some Asian and African countries); Countries with a regularly declining camel population mainly in central Asia, China and India and finally, countries with a severe in camel situations like; Iraq, Turkey, North part of Morroco [4];[9]. Since domestication camel has been managed in nomadic, sedentary, and transhumance systems which highly depends on environment variability [13].

Whereas in Ethiopia camel population is found in the pastoral system and was distributed along with the different belts. Specifically, the camel population is found around Kunama where reside in Tekeze valley, Irobe/Saho in Alitena valley, Raya –Kobo in Raya valley, the Afar in the Awash Valley, Somali in the Wabishebele valley and the Borena in Genelle - Dawa valley. The Afars, Somalis, and Borana are predominantly herders and are true pastoralists in the sense that they do not practice agriculture besides animals [14].

Different Camel Breed/Types and Characterization

The evolutionary history of dromedary and Bactrian camels were traced back to around 40 million years ago and Camelus ancestors were from the North American continent [5]. The small camelids that originated from North America include two domestic species (lama and alpaca) and two wild species guanaco in genus lama, and vicuna in genus vicugna [1]. The majority of the camels in the world are one-humped Arabian or dromedary camels (Camelus dromedaries) with about 85% of them in Africa. Besides dromedaries, two-humped camels (Camelus bactrianus) are also found in Asian countries [4];[15].

Camel genetics and recent advancement

Different studies used phenotypic and genetic characterization techniques which have been in progress in this regard [16]. Evidence showed that camels did not get substantial attention in genetics and breeding aspects while comparing with other domestic animals. However, in very recent because of their unique characteristic of morphological and physiological characteristics which help them to produce even in the harsh environment has been attracted by scholars [5]; [16]. Besides, researchers attempted to determine genetic

diversity in the current camel population which includes genetic and breed characterization of the camels [17]; [12]. The recent developments focused on molecular-genetic techniques were tested to identify differences between individuals at the DNA level. On the other hand, genetic polymorphism in mitochondrial ATP6 and ATP8 genes has been used as recent advancements [18]. It has been reported the sequencing growth hormone gene and discovery of SNPs, have significant roles in genetic markers that could be used for 'marker-assisted selection in future camel breeding programs while Genotype and allele frequencies could be described in the growth hormone[17]; [15]. Therefore, the technology advancement of a camel on genetics and breeding has been progressing in countries like UAE, Saudi Arabia, and India while others are still struggling with the traditional [24].

Camel breeding techniques

Fundamentally, the breed is defined as a population or group of animals having a common origin and similar identifying characteristics that distinguish them from another population of the same species which directly tell about breed characterizations in terms of phenotype, genetic makeup, and/or performance potential [19]. The indigenous knowledge and seasonal breeding calendar of camels practices with a selection of males for specific criteria [9]. Traditionally the keepers have been gone for the male' with high performance in milk production [20]. Furthermore, [8] has been reported the traditional selection parameters for males were body confirmation, offspring heritability evaluations, milk production traits, and some growth characters as best male. Even currently, camel populations in Ethiopia usually reflect the area where they are kept or the tribe/clan who keeps them rather than their distinct attributes [21]. In Ethiopia, camel herders mainly depend on the selection of breeding males where precisely certain criteria are important for males as well as females. The specific criteria are; effectiveness in milk production of dam and fitness of the male's sire, also as selected males, reach maturity the act of rutting behavior which includes libido and development of dulla are also important. In Ethiopia, a study conducted by [22] aimed at seventeen morphometric variables examined to determine intraspecific variation among 8 pastoralist- designated breeds of camels. However, they have been reported that genetic analysis of cytochrome-b and microsatellite data failed to support any unique genetic lineage or statistically significant camel population structure in Ethiopia.

In the modern world camel, the studied on breed standardization is inadequate to compare with other livestock. Nevertheless, few articles have been drafted on the camel breed standard for the selection of milk performance [9]. The recent advancement of camel breeds is classified based on their function (racing, draught, or milk) or their habitat like lowland and mountain type [23].

The available information, the breeds characterizations at the phenotypic, and molecular genetic level are important to establish the current status of the different camel species and breeds that economically important in different agro-climatic [12]. But in Ethiopia, still, molecular characterization of camels breed is behind and even camel breed characterization is not clear cut parameters across the world which is manifested on the breed categorizations in different parts of the world that similar names have been given to different breeds[4];[24].

Based on the milk production potential, dairy camels' breed types can be classified into three groups, high, medium, and low, based on their milk production which the high and medium milk-producing camels are considered as true dairy camel types [23]

Advancement in reproduction technologies

The advanced techniques in camel reproduction have been progressed from the dependency of naturally seasonal breeding calendars. The significant achievements reported from UEA, Egypt, and Saudi Arabia [8] and better even in Sudan compared with Ethiopia. Those advancements on the application of AI, clear Cryopreservation of sperm, synchronization of ovulation, embryo transfer in accelerating genetic improvement in lactating dromedary camels [19]; [24]. Moreover, the effect of extenders on liquefaction time and sperm quality parameters, as well as glycerol concentrations in Tris-based extenders on post-thaw quality and in-vivo fertility as identified through intensive studies, were sperm parameters such as motility, viability and plasma membrane integrity was augmented due to increased level of glycerol in semen extender [12];[25]. It was reported that UAE recorded two significant achievements on reproduction technology advancement where the world's first cloned camel was born on April 8, 2009, and the world's first AI calf was born on January 12, 2018" [10];[26]; [25]. Besides, Egypt established a semen bank for elite camel breeds that could be vital for the improvement of the low reproduction performance of camels [24].

Therefore, the advancement of reproductive techniques have been made advantages over natural breeding; such as reduction of injuries (during natural mating), facilitation of rapid dissemination of superior genetics, restriction of spreading infectious and transmitted diseases, in addition to prolongation of the reproductive lifespan of males even beyond their death. For this reason, there are considerable interests in the use of AI in Camel breeding programs. During the last two decades, several scientific efforts have been conducted to utilize AI and ET techniques to improve the reproductive performance of elite camel and female camels [24]; [27]. Moreover, the advancement of semen preparation protocol, in vitro fertilization, epididymal spermatozoa frozen are shown better than natural ejaculated sperm and sexual behavior score criteria have been developed for a male camel.

Advancement in Camel Production Technologies

Production systems

Nowadays, intensification of camel farming has been introduced to improve the production and productivity of camels in most countries where hosting a population of camels in the world [4]. Hence, the production system is likely to change from traditional to a modern system and In UAE camel production system has been shifted from traditional into a commercial system where it was believed that camel grazing is one of the ecological threats for the desert ecosystem [28]. Hence, the efforts were supported by the integration of irrigation development for the rehabilitation process as well [4]. It has been reported by [29], one of the largest camel dairy farms is located in Dubai and holds 2200 camels where practicing milking machines for production.

In Saudi Arabia, it was reported that Camel production system changes took place during the petroleum era which attracted most pastoralists to settle in urban areas. Nowadays, the increased demand for camel milk by a growing urbanized population has been stimulating the development of peri-urban camel dairy production [30].

However, in most of the East African countries (Somali, Kenya, and Sudan) has been practiced under three main production system which are; traditional /nomadic system, transhumant or semi-nomadic system but in Ethiopia camel has been kept under pure pastoral system [15]. However, recent advancements in shifting production systems into semi extensive are practiced around town and villages in the marginal area. Nowadays camel production system is classified broadly into extensive, semi-extensive, and intensive system of camel production while the intensive system is mostly followed in cities/big towns wherever camels are used as a source of livelihood by transporting various materials such as food grains, building materials, and fodder [31]. It was reported that in Sudan also in good progress that traditional subsistence camel production system is evolving into commercial dairying [32]. Whereas in Ethiopia, the pilot project was initiated around Gode town of Somali regional state which was tested as peri- urban-based camel management but it was no longer beyond [28].

Therefore, the milestones for the progress of camel production system advancement across the world can be summarized;

- The camel milk market reconciliation has been set up in numerous nations with a genuine case of the Middle East. It was not being sold camel especially the pastoralist society where social conduct was the fundamental preventive for that. Nevertheless, due to the current booming of camel milk demand of urban settlers, shifting of the pastoral production system into an intensification of camel farming systems are vital contributions.
- The advancements of camel milk processing technology like cheese making, butter, yogurt have been added to changing creation frameworks and milk consumptions which were traditionally fresh or fermented but nowadays high demand for those processed milk products
- Environmental management in this respects the advancement of the production system has been focused to accomplish through modernizing the camel production system; battling desertification through the recovery of perusing land biological systems.
- improvement reactions were accomplished in the steering of camel dairy plants were probably going to contribute for camel milk advertise as far as linkage and start the foundation of camel milk preparing industrial facility in various nations. A genuine model in Mauritania where business camel dairy cultivating has been powerful.
- The escalation of reproductive biotechnology and new breeding like artificial insemination, embryo transfer, cloning, early weaning, or artificial milking of the young has been considered as positive for newly emerging systems.
- Introduction and the substantial response of camel milking machines at big farm sizes in countries like Emirates, Saudi Arabia, Central Asia without a significant effect on udder health and animal.

Advancement in the camel housing system

Despite the harsh climate where mostly camels are living, the existing practices of the housing system have not to be changed from the traditional open and free housing. However, well fenced and ventilated housing was introduced in a few Arabian peninsula countries [23]. In Ethiopia, the housing system for camels is usually in a traditional barn made of thorny bushes and tree branches around homesteads. It is not a common practice to keep camels with other species in a single barn and some may leave free near the house during night time [21].

Economic values of the camel

The significant elements of a camel for producers were noticed that milk, meat, fleece, hair and covers up and serve for riding, as a helper animal weight and as a draft power for agribusiness and transport [7]. While, In Ethiopia, Domestic uses of camel include carrying grain, commodities from the market, and large quantities of drinking water from wells both for people and for calves in the dry season and as draft power [21].

The current blasting exchange and developing universal enthusiasm for camel milk utilization to its double elements of nourishing and remedial, Therefore, wholesome capacities are; for increasingly broadened items [33]; [34]. Healthfully, the camel milk contains lower protein, fat and lactose, more significant levels of iron, zinc, copper, potassium, sodium and calcium, low cholesterol, higher nutrient C, and defensive proteins [35].

Technology advancement in a milk product and processing aspect

Camel milk production and collection has been in progress in a most country where camel milking currently using a machine for milking and milk collection practices in human contamination free. However, the milking practices in Ethiopia, producing milk flow with the presence of a calf or its skin in cases of calf absent through massage has been an easy way of inducing continued milk. Washing of hands, milking vessels, the udder, and teats is not practiced by many before milking the camels. Besides, the milking area is generally full of dust and dung and without shade [36]; [21].

It has been noted that the number of scientific studies shown camel milk contamination could occur at four levels such as within the udder, after harvest, from the surface of equipment used for milk processing, and during storage and transport[37]; [38] ;[39]. Kenya has been made progress on the milk quality and hygienic promotion approaches through “Milk Can Revolution” and standardization for raw and pasteurized camel milk has been supported by technology which focused on the safe for human consumption [40].

It was described by [41], Camel milk is far better than cow milk, and properties resemble mother’s milk. Many studies have reported, that camel milk has a very high concentration of mono-and polyunsaturated fatty acids, serum albumin, lactoferrin, immunoglobulin’s, vitamins C, and E, lysozyme, manganese, and iron, as well as the hormone insulin in composition.

Furthermore, several scientific evidence points to the possibility of transforming camel milk into products by optimization of the processing parameters the current camel milk products such as cheese, yogurt, or butter using the same technology as for cow’s milk which indicated as this processing is difficulties and inferior quality [4]; [42].

Therefore, the advancements or discoveries of medicinal values of camel milk have been positively playing role camel development. The camel is using to treat human-related diseases in many parts of the word like; against gastrointestinal disorders, against sugar diseases, food allergy, Hepatitis C and B, reduce high cholesterol in the blood, strengthen the immune system, against cancer, autism

and for tuberculosis patients [43], [7], [44], [33], [34].

Technology Advancement on Camel Market

The sustainability of such a market is depending on two main aspects: security and health constraints. The camel stock market for export is widely "informal" with no official declaration [1]. The camel meat annually produced in Ethiopia is 74 thousand tons valued at 3614 million [45].

Camel live and meat markets are not well developed, but profitable export opportunities to Egypt, Libya, Saudi Arabia, and the Gulf States exist. Camels are sold only during times of crisis and when there is a need to balance the sex ratio of the herd. The preference is to have more females than males to ensure a good supply of milk and reproductive potential [46]. The camel milk and their product are available in the United Arab Emirates (UAE) and Indian market in a fresh or pasteurized form where Emirates industry for camel milk are leading the milk processing respectively [33],[47].

Technology Advancement, Challenges, and Opportunities

Challenges

- Institutional responsibility and Infrastructure: in many nations, the receptions of trendsetting innovations are encouraged by government organizations in light of the across the country benefits that intended to improve the yields of creatures. As it was noted in review every innovation needs fundamental speculations and foundations that ought to be set up.
- Limitation of assets/research subsidize: any innovation without the endorsement of exploration couldn't be compelling which implies those propelled procedures ought to be tried as the nation setting so meticulousness study is required in regards to all advanced findings on a camel production system
- High Competition of assets: The escalation of the camel production in urban and per urban likely contributed to significantly increase pressure on the water and feed resources in most cities of Ethiopia spite of the ecological advantages

The Existing Opportunities for Ethiopia

- The existence of role model countries in technology advancement can be considered a golden opportunity for Ethiopia.
- Discoveries of camel milk as wholesome and restorative qualities for human-associated ailment and increased worldwide interest for the camel
- Advancement of camel production suitability in urban and peri-urban setup and progressive product enhancement under intensive production system of a camel which likely attracts private investors very near future
- Potential of camel population in the country and plenty of research institutions including University in Ethiopia to research several issues of camels

Conclusion

In the event that Concerning dairy camel technology advances, the review was noted that noteworthy advancement of progression in camel hereditary qualities and rearing procedures; proliferation advances; milk and milk processing advances and different angles showed exhaustive this survey and expected innovation of camels on the planet thusly sent with the expectation that Ethiopia needs to find out more and should take commencements to upgrade innovation move for better enhancement for customary camel creation framework into a cutting edge framework. In general, where current climate changes and variability increasing vulnerabilities of the other livestock and degrading the hopes for future sustainability with cattle, sheep, and goats particularly in the arid areas.; there also should be further studies needed on breed categorization in Ethiopia which current camel types breed have no scientific bases. There ought to be likewise reinforcing of the camel research focus' institutional limit is additionally essential to explore those advances for Ethiopia. Accordingly, it is significantly more critical to attempt a further survey to enhance this end and now the ideal opportunity to think at strategy level on camels puts the nation's need for exploration and search for further funds to conduct research on camel technology advancements and disseminate the findings.

Acknowledgment

The authors would like to acknowledge the Arba Minch University, the Department of Animal Science and my folk's contributions

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