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# Research Article
# Evaluation of Different Types of Egyptian Milk from Biochemical Aspects

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## Abstract

**Objective:** This study aims to evaluate the variation in different kinds of Egyptian milk from the chemical point of view. **Materials and Methods:** Twenty five individual samples of different types of milk (buffalo, cow, goat, sheep and camel) were collected from lactating animals in different Egyptian districts in winter season. Samples of each type (species) were mixed to serve five bulk samples to be analyzed for their chemical composition (total solids, protein, fat, ash, lactose, galactose, amino acids, fatty acids and minerals). **Results:** Data evidenced that sheep milk had the highest protein and fat values. Analysis of mineral contents showed that goat milk had the highest content of sodium and the lowest contents of Ca, P, K and Zn. While, sheep milk have the highest contents of Ca and P. However, buffalo milk contains the highest values of Mg, Zn and Mn versus the lowest value of Na. Camel milk characterized by the highest content of K. On other hand, cow milk was rich in saturated fatty acids, while sheep milk was rich in poly-unsaturated fatty acids. Goat milk samples revealed the highest values of all essential amino acids except tyrosine, which was high in sheep milk samples. Lactose content was the highest in cow followed by goat milk while buffalo milk contained the lowest amount. On the other side, camel milk had the highest value of galactose rather than all other types. **Conclusion:** It is concluded that milk of different species of Egyptian ruminants have great variations in biochemical constituents and this is reflected on their different nutritional and health benefits.

Key words: Milk, protein, fatty acids, amino acids, minerals, lactose

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Milk is one of the most important substantial food items for plenty of people. Milk has been defined, from the nutritional point of view as "The most nearly perfect food" because of its high nutrients such as protein, fat, carbohydrates, minerals, vitamins and amino acids.

In developing countries, milk producing animals are often raised in subsistence and small holder systems. These animals are usually multi-purpose, grow and produce under difficult conditions, such as low inputs, minimum management and harsh environments. They are well adapted to local conditions, but have low genetic potential for milk production.

Cattle (cows) produce 83% of world milk production, followed by buffaloes with 13%, goats with 2% and sheep with 1% while camels provide 0.4%. In developing countries, almost all milk are produced by cattle and about one-third of milk production comes from buffaloes, goats, camels and sheep[1,2].

Milk is vary in taste, odor and physical properties according to its source and the producing spices. The variation in milk constituents may be referred to different factors: Distribution area, production scale, environmental and claimed conditions. Consumer in different habitats may prefer certain type of milk rather another. Although cattle are kept in a wide range of environments, other dairy species make dairying possible in adverse environments that often cannot support any other type of agricultural production. Sheep allow milk production in semi-arid regions around the Mediterranean, goats in regions with poor soils in Africa[3-9].

Livestock population in Egypt was recorded between 2000 and 2009 having a steady increase in numbers, particularly of cattle (from 3.53-5.00 million), buffaloes (3.38-4.00 million), goats (3.43-4.55 million) and sheep (4.47-5.50 million) over this period. Camels, however, have declined from 141000-110000 head. However, goat as well as sheep milk are less spread and consumed than other species milk types[2].

All milk types contain the same kind of constituents but in varying amounts. These variations were previously reported by many researchers[3-9].

The aim of this study is assessment the chemical constituents of different types of Egyptian milk which are consumed by various rates in different localities. Consequently, this study will help researchers to evaluate and find answers for their questions about chemical constituents of different types of Egyptian milk in one scientific paper.

## MATERIALS AND METHODS

Different milk samples of various species from different localities were collected (Camel milk from matrooh, goat and sheep milk from Kirdasa, buffalo and cow milk from private farm in Imbaba district). Individual sample of 250 mL from each animal was collected in glass bottle, kept in ice container during transportation and stored under freezing till analysis. Samples of each species were pooled in five bulk samples. Each of them was collected from 5 random individual lactating animals.

**Chemical composition:** Total Solids (TS), Total Protein (TP), fat and ash contents were determined according to AOAC[10]. Lactose and galactose contents were also estimated according to Richmond *et al.*[11] by using HPLC.

**Minerals concentration:** Minerals content was estimated according to AOAC[10] using atomic absorption spectrophotometer (Varian, AA240, Victoria, Australia) using air acetylene flame.

**Fatty acid profile estimation:** The fatty acids of milk were performed as mentioned by AOAC[10] using Gas Liquid Chromatography (GLC) technique. Fat was extracted by using soxelet apparatus (FOSS Tecator, Auckland, NZ). Fatty acid methyl esters were analyzed by gas liquid chromatography (Shimadzu GC2010) using DB-wax column. The carrier gas was helium with a flame ionization detector.

**Amino acids pattern:** Amino acids of different types of milk were estimated using HPLC[10].

**Statistical analysis:** Data were statistically analyzed using one way Anova using SPSS[12].

## RESULTS AND DISCUSSION

**Total solids content:** Results revealed great differences in chemical composition of milk from different species (Table 1). TS showed highly significant difference between milk types where it recorded the highest value in sheep (17.43%), followed by buffalo (16.56%), camel (13.32%) then cow (12.85%) while goat milk recorded the lowest value (12.62%). These results are in coincidence with Salman *et al.*[13], who found that TS of buffalo milk (15.03-15.83); their value was higher than cow milk (12.84-13.58%). In the same time,

Table 1: Chemical composition of various Egyptian milk types

| Items | Cow | Buffalo | Camel | Goat | Sheep | p-value | Significant |
|---|---|---|---|---|---|---|---|
| TS (%) | 12.85$^{a}$ | 16.56$^{b}$ | 13.33$^{a}$ | 12.62$^{a}$ | 17.43$^{b}$ | 0.0002 | *** |
| Protein (%) | 3.36$^{a}$ | 3.64$^{a}$ | 3.70$^{a}$ | 3.73$^{a}$ | 5.41$^{c}$ | 0.0001 | *** |
| Fat (%) | 4.10$^{a}$ | 6.30$^{b}$ | 4.10$^{a}$ | 3.40$^{c}$ | 6.30$^{b}$ | 0.0001 | *** |
| Ash (%) | 0.70$^{a}$ | 0.78$^{a}$ | 0.77$^{a}$ | 0.76$^{a}$ | 0.89$^{a}$ | 0.349 | NS |
| Lactose (mg $L^{-1}$) | 48.37$^{b}$ | 32.42$^{a}$ | 34.25$^{a}$ | 43.07$^{b}$ | 33.83$^{a}$ | 0.0001 | *** |
| Galactose (mg $L^{-1}$) | 0.507$^{b}$ | 0.670$^{ab}$ | 0.650$^{ab}$ | 0.045 $^{c}$ | 0.790$^{a}$ | 0.0001 | *** |

Different superscripts within the same row mean significant ($p \geq 0.01$)

El-Gendy *et al.*[14] mentioned that goat milk produced under desert condition in Egypt had total solids ranged between 12.19-12.97%. Also, these results are in agreement with Raynal-Ljutovac *et al.*[15] who reported that sheep milk has higher TS than goat milk (18.1 and 11.8% respectively). In the same time, obtained results were in coincidence with Hamad and Baiomy[5] who found that total solids value of camel milk was lower than sheep milk (14.0 and 18.0% respectively) in Qena governorate, Egypt.

**Protein content:** Results of protein content (Table 1) clarified only high significance in protein contents of sheep versus other milk types. This is in agreement with previous studies which mentioned that sheep milk has the highest protein content followed by buffalo, then goat and cow[16,17]. Cow and buffalo milk are rich in β-lactoglobulin fraction which may cause allergy to some children[18]. Those children will have an allergic reaction after ingesting buffalo, goat, sheep and horse milk protein due to the presence of positive immunological cross reaction with their counterparts in cow milk[19]. Camel milk is a good substitute as human milk as it does not contain β-lactoglobulin which is present in bovine milk but contains immuno-globulins similar to human; so it reduce the allergic reaction and increase their future immune response[20].

**Fat content:** Regarding to fat content, present results showed that both sheep and buffalo milk were significantly higher in fat content than other species, while no significant difference was noticed in between. Similar to these findings, Hamad and Baiomy[5] reported that fat content of cow and buffalo in Qena governorate were 4.28 and 7.80% respectively. They also concluded that concentration of fat in milk depends on some factors such as breed, nutrition, individual traits and period of lactation. Despite, sheep milk is rich in fat and protein more than other types of milk. Also, it is less used on large scale in dairy industry in Egypt where it is not reared or considered as dairy animal, it produce only 93000 t milk yearly also, the sheep breeds in Egypt are of low genetic value[21]. Little studies were carried out on manufacture of dairy product from small ruminant's milk in spite of being healthy and preferred for patients having cardiovascular disease, cancer, obesity and diabetes where it is rich in essential fatty acids[22].

**Ash content:** Referring to ash contents, Table 1 showed non-significant variation between different types of milk. The obtained results were in agreement with previous studies[16,17].

**Lactose and galactose content:** Data presented in Table 1 illustrated that cow milk had the highest content of lactose (48.3 mg $L^{-1}$) followed by goat (43.07 mg $L^{-1}$). The other three types had nearly the same content of lactose. On the other hand, galactose content of the five types of milk ranged between 0.045-0.790 mg $L^{-1}$; where sheep milk had the highest value and goat had the lowest. Camel milk had low level of lactose if compared to the other types of milk similar results were obtained by Hashim[23]. There is a traditional believe in middle east that regular consumption of camel milk helps in control of diabetes. Recently, it was suggested by Malik *et al.*[24] that camel milk contains insulin like small molecule substance that mimic insulin interaction with its receptors. In another study on diabetic patients Khan *et al.*[25] found that when patients received camel milk, their insulin requirement reduced to zero level. In the same time, camel milk is more favorable to individuals having lactose intolerance where it controls the gastrointestinal disorders resulting from intake of cow milk[26].

**Minerals concentration:** Results (Table 2) showed the average contents of minerals in various types of Egyptian milk. Concerning calcium and phosphorus, which are the most important elements for bone growth, development, metabolism general health maintenance. Results revealed that sheep milk had the highest content of calcium and phosphorus followed by camel and buffalo milk. While, cow and goat milk contained the lowest values of both elements. Raynal-Ljutovac *et al.*[15] clarified that sheep milk had the highest content of Ca and P compared to goat and human milk. As well, Abd El-Salam and El-Shibiny[1] and Ahmad *et al.*[27] mentioned that buffalo milk had higher Ca content (about 1.5 fold) than cow milk. The noteworthy is that most of calcium in buffalo milk is found in insoluble form due to the high casein contents.

Goat milk showed the highest content of sodium (2612 mg $L^{-1}$) which represented four folds higher than

Table 2: Minerals content of various Egyptian milk types (mg $L^{-1}$)

| Minerals | Cow | Buffalo | Camel | Goat | Sheep | p-value | Significant |
|---|---|---|---|---|---|---|---|
| Ca | 0.133$^{b}$ | 0.162$^{b}$ | 0.142$^{b}$ | 0.053$^{a}$ | 0.172$^{b}$ | 0.0001 | *** |
| P | 0.093$^{a}$ | 0.120$^{a}$ | 0.097$^{a}$ | 0.050$^{a}$ | 0.135$^{a}$ | 0.768 | NS |
| Na | 553.2$^{b}$ | 505.90$^{b}$ | 618$^{b}$ | 2612$^{a}$ | 515.60$^{b}$ | 0.0001 | *** |
| K | 1489$^{c}$ | 1109$^{b}$ | 2014$^{a}$ | 650.7$^{d}$ | 1862$^{a}$ | 0.0001 | *** |
| Mg | 121.80$^{c}$ | 173.30$^{a}$ | 76.69$^{b}$ | 114.60$^{c}$ | 158.00$^{a}$ | 0.0001 | *** |
| Zn | 2.75$^{b}$ | 3.59$^{a}$ | 3.04$^{ab}$ | 1.54$^{c}$ | 3.03$^{ab}$ | 0.0004 | *** |
| Mn | 0.84$^{b}$ | 1.40$^{a}$ | 0.49$^{c}$ | 0.99$^{b}$ | 0.54$^{c}$ | 0.0001 | *** |

Different superscripts within the same row mean significant ($p \geq 0.01$)

Table 3: Fatty acids profile of various Egyptian milk types

| Fatty acid (%) | Cow | Buffalo | Camel | Goat | Sheep | p-value | Significant |
|---|---|---|---|---|---|---|---|
| SFAs | 63.45$^{c}$ | 58.73$^{b}$ | 60.23$^{b}$ | 52.14$^{a}$ | 58.83$^{b}$ | 0.0001 | *** |
| TUFAs | 30.22$^{a}$ | 58.73$^{c}$ | 60.23$^{c}$ | 31.74$^{a}$ | 34.74$^{b}$ | 0.0001 | *** |
| PUSAs | 4.27$^{b}$ | 2.00$^{a}$ | 3.77$^{ab}$ | 14.04$^{c}$ | 5.24$^{b}$ | 0.000 | *** |

Different superscripts within the same row mean significant ($p \geq 0.01$), SFAs: Saturated fatty acids, TUFAs: Total unsaturated fatty acids, PUSAs: Poly-unsaturated fatty acids

buffalo and cow milk (505.9 and 553.2 mg $L^{-1}$) respectively. So, it is less palatable due to its salty taste and that is why it is less consumed in Egypt than buffalo and cow milk in spite of its healthy characteristics.

Camel milk was rich in K rather than all types of milk (650 mg $L^{-1}$). Similar results were obtained by Shamsia[28]. Recent study showed that the decline in potassium levels in our bodies were associated with decline in insulin release and pancreatic β-cell sensitivity to hyperglycemia which was experimentally maintained with glucose infusions[29]. A recent study suggested that increased potassium intake may play a role in the prevention and treatment of hypertension[30].

Camel milk had the lowest amount of Mg, where it contains 76.7 mg $L^{-1}$, versus 173.3 mg $L^{-1}$ for buffalo milk, while other types of milk contained different values of Mg which were 114.6, 121.8 and 158 mg $L^{-1}$ for goat, cow and sheep milk respectively. Magnesium is a cofactor in more than 300 enzyme systems that regulate diverse biochemical reactions in the body, including protein synthesis, muscle and nerve function, blood glucose control and blood pressure regulation[31,32]. Magnesium is required for energy production, oxidative phosphorylation and glycolysis. It contributes to the structural development of bone and is required for the synthesis of DNA, RNA and the antioxidant glutathione. Magnesium also plays a role in the active transport of calcium and potassium ions across cell membranes, a process that is important to nerve impulse conduction, muscle contraction and normal heart rhythm[32].

Concerning trace elements, buffalo milk showed the largest values of zinc followed by camel, sheep, cow and finally goat milk. Zinc is associated with more than 50 distinct metallo-enzymes, which have a diverse range of functions, including the synthesis of nucleic acids and specific proteins, such as hormones and their receptors. Zinc also plays a critical role in physical growth and gastrointestinal and immune function[33]. Buffalo milk also had the highest value of Mn while camel milk had the lowest value. Manganese is a cofactor in large number of enzymes like oxidoreductases, transferases, hydrolases, lipases, isomerases, ligases, lectins and integrin's[34]. In the human brain, the manganese is bound to manganese metallo-proteins, most notably glutamine synthetase in astrocytes[35].

**Fatty acids profile:** Data presented in Table 3 revealed the fatty acids profile of different types of Egyptian milk. Saturated fatty acids (SFAs) contents of different types of milk showed little variation. Cow milk had 63.45% followed by camel milk which contained 60.23%. Sheep and buffalo milk had almost the same content (58.83 and 58.72% respectively) Goat milk came at the lowest order (52.14%). Total unsaturated fatty acids (TUSFAs) are the highest in sheep milk where it contains 34.74%, while camel milk came in the second order; it had 33.81% followed by goat milk (31.74%) and cow (30.22%) then buffalo milk came in the last order (27.19%).

As for polyunsaturated fatty acids (PUSFAs), goat milk contained the largest value (14.4%) compared with the other types of milk. Previous results illustrated that milk is one of the most complex natural fats that consist of approximately 400-500 fatty acids[36]. It is well known that cow and buffalo milk are rich in saturated fatty acids (60-70%). The main saturated fatty acids in milk fat; of the majority of mammals is C16:0. While, in sheep and goat, the milk fat is a rich source of unsaturated fatty acids C6:0, C8:0 and C10:0[22]. Camel milk had higher content of long chain fatty acids (C-14 to C-18) and lower content of short chain fatty acids (C-4 to C-14). These poly-unsaturated fatty acids are very essential to human

Table 4: Amino acids pattern of various Egyptian milk types

| Amino acid (%) | Cow | Buffalo | Camel | Goat | Sheep |
|---|---|---|---|---|---|
| Aspartic | 0.28 | 0.21 | 0.20 | 0.61 | 0.22 |
| Threonine | 0.13 | 0.15 | 0.12 | 0.38 | 0.15 |
| Serine | 0.14 | 0.15 | 0.12 | 0.41 | 0.16 |
| Glutamic | 0.67 | 0.50 | 0.53 | 1.22 | 0.54 |
| Proline | 0.33 | 0.35 | 0.27 | 0.58 | 0.37 |
| Glycine | 0.06 | 0.06 | 0.04 | 0.17 | 0.07 |
| Alanine | 0.13 | 0.12 | 0.07 | 0.30 | 0.13 |
| Valine | 0.23 | 0.19 | 0.15 | 0.48 | 0.19 |
| Isoleucine | 0.18 | 0.15 | 0.13 | 0.31 | 0.18 |
| Leucine | 0.34 | 0.26 | 0.24 | 0.65 | 0.28 |
| Tryptophane | 0.13 | 0.12 | 0.12 | 0.02 | 0.16 |
| Phenylalnine | 0.23 | 0.16 | 0.12 | 0.32 | 0.17 |
| Histidine | 0.13 | 0.09 | 0.08 | 0.23 | 0.09 |
| Lysine | 0.30 | 0.21 | 0.19 | 0.55 | 0.23 |
| Argenine | 0.12 | 0.10 | 0.11 | 0.26 | 0.10 |
| Cysteine | 0.06 | 0.03 | 0.01 | 0.16 | 0.03 |
| Methionine | 0.06 | 0.07 | 0.05 | 0.10 | 0.09 |

nutrition[28,37]. Mono-unsaturated fatty acids do not cause accumulation of cholesterol as saturated fats and do not turn rancid as readily as polyunsaturated fatty acids[38]. Moreover, they have a positive effect on the concentration of High Density Lipoproteins (HDL), transporting cholesterol from blood vessel walls to the liver, where it is degraded by bile acids, which are afterwards excreted from the organism. At the same time, mono-unsaturated fats reduce the concentration of Low Density Lipoproteins (LDL), which when circulating over the entire organism are deposited in blood vessels[22].

Many studies indicated that higher USFAs in the diet supports prevention of cancer, heart diseases, thrombosis, arterial hypertension, hyperlipidemia, Alzheimer's, depression and rheumatoid arthritis[39]. In this respect sheep, goat and camel milk are considered healthier for those patients having high lipid profile.

**Amino acid pattern:** Table 4 declared the variation in amino acids content of different types of Egyptian milk. Goat milk had the highest value of all amino acids except tyrosine (0.02%). Camel milk had most of amino acids compared to cow and buffalo milk. Sheep milk had the highest tyrosine and methionine contents (0.16 and 0.091%) respectively. Sabahelkheir *et al.*[40] stated that sheep, goat, camel and cow milk are very rich in all essential amino acids except methionine.

The essential and non-essential amino acids affect a broad range of physical and mental processes in our bodies. Recent studies have witnessed the discovery that amino acids are cell signaling molecules as well as being regulators of gene expression and the protein phosphorylation cascade. There is evidence that branched-chain amino acids improved mental performance and decrease fatigue[41]. In coincidence to present results, Shamsia[28] reported that camel milk is characterized by high contents of all amino acids except lysine, glycine, threonine and valine. Generally, the amino acids pattern of camel milk proteins revealed that they have the satisfactory quality balance of essential amino acids for human diet or exceeding the requirements of amino acids[42]. Camel milk is easily digested by microorganisms particularly non-protein bound amino acids. Recently, camel milk when used in starter culture preparation, showed high metabolic activity. It was concluded that the beneficial microbiota of camel milk (represented by lactic acid bacteria) could be a potential source of biological material to be used in dairy technology[43]. It was recommended to pay more effort to obtain new functional ingredients to venture force the dairy industry from camel milk and carry out more research work towards its functional properties and genetic analysis.

## CONCLUSION

Finally; it could be concluded that there are great variations of the biochemical constituents of milk samples obtained from different Egyptian ruminants according to the species. Special care and attention should be paid for sheep, goat and camel milk to be produced on large scale and this can be achieved through large dairy farm establishment, super genetic selection and good health care and management. Further intensive studies should be carried out for the production of dairy products from these types of milk to cover the needs of local market. The milk per capita should be elevated in Egypt especially in arid and semi-arid areas which depend mainly on milk as a source of protein. If these desert ruminants got better management, may save millions of dollars spent on milk and dairy products importation.

## REFERENCES

1. Abd El-Salam, M.H. and S. El-Shibiny, 2011. A comprehensive review on the composition and properties of buffalo milk. Dairy Sci. Technol., 91: 663-699.
2. El-Nahrawy, M.A., 2011. Country pasture/forage resource profiles: Egypt. Food and Agriculture Organization of the United Nations, Rome, Italy. http://www.fao.org/ag/agp/agpc/doc/counprof/PDF%20files/Egypt.pdf
3. Al Haj, O.A. and H.A. Al Kanhal, 2010. Compositional, technological and nutritional aspects of dromedary camel milk. Int. Dairy J., 20: 811-821.
4. Agrawal, R.P., S.C. Swami, R. Beniwal, D.K. Kochar, M.S. Sahani, F.C. Tuteja and S.K. Ghorui, 2003. Effect of camel milk on glycemic control, lipid profile and diabetes quality of life in type 1 diabetes: A randomised prospective controlled cross over study. Indian J. Anim. Sci., 73: 1105-1110.

5. Hamad, M.N.E. and A.A. Baiomy, 2010. The physical and chemical properties of camel's and sheep's milk in Qena Governorate. J. Food Dairy Sci. Mansoura Univ., 1: 405-412.
6. Nikkhah, A., 2011. Science of camel and yak milks: Human nutrition and health perspectives. Food Nutr. Sci., 2: 667-673.
7. Sabahelkhier, M.K., M.M. Faten and F.I. Omer, 2012. Comparative determination of biochemical constituents between animals (goat, sheep, cow and camel) milk with human milk. Res. J. Recent Sci., 1: 69-71.
8. Abbas, H.M., F.A.M. Hassan, M.A.M. Abd El-Gawad and A.K. Enab, 2014. Physicochemical characteristics of goat's milk. Life Sci. J., 11: 307-317.
9. Sania, M.A., A.M. Abd El-Aty, M.E. Shenana and G.M. Emara, 2015. Using ultrafiltration technique in making white soft cheese from camel milk. Egypt. J. Dairy Sci., 43: 79-93.
10. AOAC., 2012. Animal Feed. In: Official Methods of Analysis of AOAC International, Latimer, Jr. G.W. (Ed.). 19th Edn., Chapter 4, AOAC International, Gaithersburg, MD., USA., pp: 18-19.
11. Richmond, M.L., B.R. Harte, J.I. Gray and C.M. Stine, 1987. Determination of sugars in yogurt and microbiological media by high performance liquid chromatography during processing and subsequent storage. J. Dairy Sci., 70: 1140-1147.
12. SPSS., 2011. Statistical Package for Social Science, Release 20.0.0. SPSS Inc., Chicago, IL., USA.
13. Salman, M., M. Khaskheli, Israr-Ul-Haq, A.R. Talpur and A.P. Khuhro *et al*., 2014. Comparative studies on nutritive quality of buffalo and cow milk. Int. J. Res. Applied Nat. Social Sci., 2: 69-78.
14. El-Gendy, M.H., M.M. Desouky and H. El-Shaer, 2014. Physicochemical properties and minerals profile of shami goats' milk produced under desert conduction. J. Food Dairy Sci., 5: 377-387.
15. Raynal-Ljutovac, K., G. Lagriffoul, I. Guillet and Y. Chilliard, 2008. Composition of goat and sheep milk products: An update. Small Rumin. Res., 79: 57-72.
16. Mahmood, A. and S. Usman, 2010. A comparative study on the physicochemical parameters of milk samples collected from buffalo, cow, goat and sheep of Gujrat, Pakistan. Pak. J. Nutr., 9: 1192-1197.
17. Guetouache, M., B. Guessas and S. Medjekal, 2014. Composition and nutritional value of raw milk. Issues Biol. Sci. Pharmaceut. Res., 2: 115-122.
18. Lara-Villoslada, F., M. Olivares and J. Xaus, 2005. The balance between caseins and whey proteins in cow's milk determines its allergenicity. J. Dairy Sci., 88: 1654-1660.
19. El-Agamy, E.I., M. Nawar, S.M. Shamsia, S. Awad and G.F.W. Haenlein, 2009. Are camel milk proteins convenient to the nutrition of cow milk allergic children? Small Rumin. Res., 82: 1-6.
20. Shabo, Y., R. Barzel, M. Margoulis and R. Yagil, 2005. Camel milk for food allergies in children. Isr. Med. Assoc. J., 7: 796-798.
21. FAO., 2004. FAOSTAT database. Food and Agriculture Organization of the United Nations, Rome, Italy.
22. Markiewicz-Keszycka, M., G. Czyzak-Runowska, P. Lipinska and J. Wojtowski, 2013. Fatty acid profile of milk-a review. Bull. Vet. Inst. Pulawy, 57: 135-139.
23. Hashim, B.I., 2002. Acceptance of camel milk among elementary school students in Al Ain City, United Arab Emirates. Emir. J. Food Agric., 14: 54-59.
24. Malik, A., A. Al-Senaidy, E. Skrzypczak-Jankun and J. Jankun, 2012. A study of the anti-diabetic agents of camel milk. Int. J. Mol. Med., 30: 585-592.
25. Khan, A.A., M.A. Alzohairy and A.H. Mohieldein, 2013. Antidiabetic effects of camel milk in streptozotocin-induced diabetic rats. Am. J. Biochem. Mol. Biol., 3: 151-158.
26. Mal, G., D.S. Sena, V.K. Jain and M.S. Sahani, 2001. Therapeutic utility of camel milk as nutritional supplement in chronic pulmonary tuberculosis. Livest. Int., 7: 4-8.
27. Ahmad, S., F.M. Anjum, N. Huma, A. Sameen and T. Zahoor, 2013. Composition and physico-chemical characteristics of buffalo milk with particular emphasis on lipids, proteins, minerals, enzymes and vitamins. J. Anim. Plant. Sci., 23: 62-74.
28. Shamsia, S.M., 2009. Nutritional and therapeutic properties of camel and human milks. Int. J. Genet. Mol. Biol., 1: 52-58.
29. Chatterjee, R., H.C. Yeh, D. Edelman and F. Brancati, 2011. Potassium and risk of type 2 diabetes. Exp. Rev. Endocrinol. Metab., 6: 665-672.
30. Perez, V. and E.T. Chang, 2014. Sodium-to-potassium ratio and blood pressure, hypertension and related factors. Adv. Nutr., 5: 712-741.
31. Rude, R.K., 2010. Magnesium. In: Encyclopedia of Dietary Supplements, Coates, P.M., J.M. Betz, M.R. Blackman, G.M. Crag, M. Levine, J. Moss and J.D. White (Eds.). 2nd Edn., Informa Healthcare, New York, USA., ISBN-13: 9781439819289, pp: 527-537.
32. Rude, R.K., 2012. Magnesium. In: Modern Nutrition in Health and Disease, Ross, A.C., B. Caballero, R.J. Cousins, K.L. Tucker and T.R. Ziegler (Eds.). 11th Edn., Lippincott Williams and Wilkins, Baltimore, MA., USA., ISBN-13: 978-1605474618, pp: 159-175.
33. Brown, K.H., S.E. Wuehler and J.M. Peerson, 2001. The importance of zinc in human nutrition and estimation of the global prevalence of zinc deficiency. Food Nutr. Bull., 22: 113-125.
34. Law, N.A., M.T. Caudle and V.L. Pecoraro, 1998. Manganese redox enzymes and model systems: Properties, structures and reactivity. Adv. Inorg. Chem., 46: 305-440.
35. Takeda, A., 2003. Manganese action in brain function. Brain Res. Rev., 41: 79-87.
36. Barlowska, J. and Z. Litwinczuk, 2009. Nutritional and pro-health properties of milk fat. Medycyna Weterynaryjna, 65: 171-174.

37. Narmuratova, M., G. Konuspayeva, G. Loiseau, A. Serikbaeva, N. Barouh, D. Montet and B. Faye, 2006. Fatty acids composition of dromedary and Bactrian camel milk in Kazakhstan. J. Camel Pract. Res., 13: 45-50.
38. Collomb, M., A. Schmid, R. Sieber, D. Wechsler and E.L. Ryhanen, 2006. Conjugated linoleic acids in milk fat: Variation and physiological effects. Int. Dairy J., 16: 1347-1361.
39. McManus, A., M. Merga and W. Newton, 2011. Omega-3 fatty acids. What consumers need to know. Appetite, 57: 80-83.
40. Sabahelkheir, M.K., M.M. Fat and A.A. Hassan, 2012. Amino acid composition of human and animal's milk (camel, cow, sheep and goat). ARPN J. Sci. Technol., 2: 32-34.
41. Wu, G., 2009. Amino acids: Metabolism, functions and nutrition. Amino Acids, 37: 1-17.
42. FAO/WHO/UNU., 1985. Energy and protein requirements. Report of the FAO/WHO/UNU Expert Consultation Technical Series No. 724, World Health Organisation, Geneva, Switzerland.
43. Ashmaig, A., A. Hasan and E. El Gaali, 2009. Identification of lactic acid bacteria isolated from traditional Sudanese fermented camel's milk (*Gariss*). Afr. J. Microbiol. Res., 3: 451-457.