Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2024, 11(11):73-79**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Evaluation of the Chemical and Microbial Quality of Raw Milk Sold at the Markets in Hodeidah City-Yemen

Galal Ahmed Al-Askari[1*], Ezzy Ahmed Faqeh[2] and Shamsan Al mowallad [3]

[1]Department of Food Industries Engineering, Faculty of Engineering, Hodeidah University, Hodeidahh, Yemen.
[2]Department of Environmental Science, Faculty of Marin sciences and environment, Hodeidah University, Hodeidah, Yemen.
[3]Department of food Science and Technology. Faculty of Agriculture and Food Science. Ibb University, Ibb, Yemen
*Corresponding author: ecogalal@gmail.com

Abstract: This research aimed to evaluate the chemical and microbial quality of raw milk sold at the markets of Hodeidah city. Ten raw milk samples were collected from different markets, in addition two samples of brand pasteurized milk for comparison. The specific gravity, total solids, pH, acidity, fat percentage and protein percentage were estimated. The total number of bacteria, total coliform bacteria, yeasts and molds was stimated as microbial quality.

The results showed that 60% of the samples had a specific gravity below normal limits as a result of adulteration of milk with water, while one sample obtained a high specific gravity (1.036), which is an indication of the addition of powdered milk. There was significant difference among the different samples in Total Solid (TS) and sample S7 was the lowest (9.47%). The pH of some samples decreased below the normal limits for raw milk, in addition to the increase in titratable acidity as a result of microbial activity in the milk. Samples S4 and S7 had low fat percentages, this may be due to the nature of the milk or part of the milk fat was removed. Protein percentages were within normal limits for milk, except for sample S3, which was (4.82%) as a result of the possible addition of powdered milk. Microbial analysis results showed a high number of total bacteria in raw milk samples compared to pasteurized milk. Coliform bacteria were also present in 60% of the samples, in addition yeasts and molds were presence of in high numbers.

Keywords: Raw milk, Chemical Quality, Microbiological Quality, Hodeidah Markets

1. Introduction

Milk is considered one of the best foodstuffs with high nutritional value because it contains all nutritional elements and is considered one of the important foods in human nutrition at all stages of life (Xulu et al., 2019). Cow milk constitutes 85% of the commercial level in all countries of the world, followed by buffalo milk (11%), and then goats and sheep at 2% each. Cow's milk contains varying percentages of known nutritional elements, in addition to a good percentage of vitamins and mineral elements (Eckles et al., 1951). Milk quality is determinate according to a set of standard criteria such as the amount of impurities, specific gravity, percentage of fat and protein, in addition to the total number of bacteria and pathogenic bacteria (FAO, 2008). Milk production process is one of the factors affecting its chemical and microbial quality, Sometimes, milk is adulterated by adding water, removing part of its components, or adding some substances that prevent the deterioration of milk or preserve its chemical properties (Hempen et al., 2004). Also, lack of care of the milk during the milking process can lead to a rapid change in its characteristics and thus rapid spoilage, therefore, producing milk with acceptable standards is a challenge for farmers and livestock breeders, which is what

associations and official bodies seek to do by awareness and training them on methods of proper production of milk and thus the possibility of marketing it (Tola, 2002).

This research aimed to evaluate the chemical and microbial quality of raw milk sold at the markets in Hodeidah city.

2. Materials and Methods

Milk samples: Milk sellers display raw milk in the main markets in metal containers and then divide it into plastic bags without conducting any treatments. Therefore, ten samples of raw milk collected from different markets in Hodeidah city, randomly, in addition to samples of pasteurized milk manufactured by local companies. The samples were placed in a refrigerated container and transported to the laboratory to conduct the necessary chemical and microbial analysis.

Chemical analysis: Specific gravity and pH were carried out using the method described by Awal et al., (2016), while the total acidity in the milk was measured using the titration method according to what was mentioned by Aggarwal and Sharma (1961). Milk fat was estimated using Gerber method (Goss, 1953), while total solids (TS) was estimated according to the method described by AOAC (2003). Protein estimation was carried out using the Kjeldahl method according to Pearson (1977).

Microbial analysis: Total number of bacteria, coliforms, yeasts, and molds was determined according to the method described by APHA (1998).

Statistical analysis: The data for the various tests were analyzed using the analysis of variance (ANOVA) method, and the Duncan multinomial test was used at the 5% probability level to determine the significant differences between the means, using the statistical analysis program STAT SAS, 1995. .

3. Results and Discussion

Chemical composition

Specific gravity (g/cm3)

Specific gravity is defined as the relationship between the gravity of a substance and the gravity of water at the same temperature. Therefore, it is a result of milk components balance, and any imbalance in these components leads to a change in the milk gravity value.

The results in table (1) showed that 60% of the samples obtained a specific gravity lower than the normal limits for gravity in raw milk (1.028-1.032 g/cm3), according to both FAO (1988) and Tamime (2009), where the gravity values for these samples ranged between 1.023-1.012 g/cm3. Sample S7 obtained the lowest value (1.012 g/cm3), the low specific gravity of the milk is considered one of the indicators of the milk adulteration process by adding water to the milk. The results agreed with what was found by Gemechu and Tesfaye, (2016), some raw milk samples had a gravity below normal limit. While the results obtained were less than Karmaker et al., (2020) and Gemechu et al. (2015). The results of the study agreed with what was reported by Eckles et al., (1951) stated that the process of diluting milk with water leads to a decrease in its specific gravity, as farmers and livestock breeders often resort to adding water to milk in order to increase its quantity (Omore et al., 2005). On the other hand, the specific gravity in sample S3 was high (1.036), and according to what O'Connor, (1995) stated, a high specific gravity in the milk is considered an indication of the addition of skim milk powder because the fat percentage was normal. While specific gravity of pasteurized milk samples P1 and P2 obtained 1.030 and 1.031 g/cm3, respectively. These results agreed with what Karmaker et al., (2020) who found pasteurized milk (1.028-1.032 g/cm3), which is within the normal limits for liquid milk.

Total Solid (TS%)

Total solids (TS) express the total solid content of milk as a percentage and include fat, sugar, protein, and salts. Results in table (1) showed significant differences between fresh milk samples in the percentage of total solids, as solids decreased in the samples that obtained low values in specific gravity, where sample S7 obtained the lowest percentage of total solids (9.47%). It is the same sample that obtained the lowest specific density value (1.012).

Results obtained agreed with the findings of Karmaker et al., (2020) and Hossain et al., (2011) that adding water to milk led to a decrease in the percentage of total solids. While sample S3 obtained the highest value that

exceeding the normal limits, which reinforces the hypothesis of adding powdered milk to liquid milk (Zelalem and Ledin, 2001).

While, there were no significant differences between the pasteurized milk samples, the results were identical to what was found by Hossain et al., (2011).

pH

The pH accurately indicates the condition of the milk, as whenever the values are within normal limits, this means that the milk is fresh.

Results in table (1) indicated that there were significant differences between the pH values of the milk samples, which ranged between 6.37-6.77. Both O'Connor, (1995) and FAO, (1999) indicated that the pH of fresh cow's milk ranges between 6.6-6.8.

Decrease of pH milk below 6.6 is considered an indication of an increase in the number of bacteria in the milk (O'Connor, (1995). This was confirmed by the results of the microbial analysis (Table 2), as in the samples whose pH was lower than 6.6, the numbers of bacteria, yeasts, and molds were high. The results of the study agreed with what was stated by many researchers, that the decrease in pH values in milk is due to an increase in the number of bacteria and their multiplication (Huque et al., (2018) and Saxena and Poonam. (2013).

Acidity (%)

Titration acidity is an indicator of the freshness of milk and bacterial activity (Hossain et al. 2011). Popescu and Angel, (2009) also indicated that high-quality liquid milk has a acidity of no more than 0.14. The results in table (1) indicate that there are significant differences in acidity values between the milk samples. Sample No. S9 obtained the highest value (0.23%), which is an indication of the high number of bacteria.

While sample S2 obtained the lowest value (0.14%), which means that the milk is good and fresh. Referring to the microbial analysis table, the microbial content of sample S2 was very low, which suggests this possibility. The results of the study agreed with the findings of Karmaker et al., (2020) in that milk samples whose acidity was high had high microbial content.

The titratable acidity of milk is expressed in terms of percentage of lactic acid, as fresh milk does not contain any appreciable amount of lactic acid, so the increase in acidity is a rough measure of the age and activity of the bacteria. Within a short period after milking, acidity increases due to increased bacterial activity and increased amount of lactic acid in the milk, and this depends on the cleanliness of production and the temperature at which the milk is kept (Saxena and Poonam, 2013).

Determining the acidity level in milk is an important factor in judging the quality of milk, as acidity affects the taste. When the acidity reaches about 0.3%, the taste of the milk becomes acceptably acidic. At 0.4% acidity, the milk is clearly sour, and at 0.6% the milk curdles as a result of the increased acidity. (sour taste) and at acidity exceeding 0.9%, milk is spoiled (Sraïri et al., 2006).

Fat (%)

The results in table (1) indicated that there were significant differences in fat percentages between the samples, ranging between 1.9 and 4.5%. Commercially and nutritionally, milk fat is considered the most important component of milk (Hossain et al., 2011).

According to the Yemeni standard specification for raw milk (12/2003), cow's milk should not be less than 3% fat, which means that samples S4 and S7 are less than the normal limits for milk fat. This could be due to the nature of the milk (low fat) or that it was conducted partial milk fat defatting (Karmaker et al., 2020).

The results of the study agreed with what was found by Samia et al., (2009) in samples of cow's milk in Sudan showed a decrease in the percentage of fat in some samples. The results of the study also coincided with what was found by Dey and Karim, (2013) that the decrease in the density of the milk may be due to the addition of water or the removal of part of the milk fat. On the other hand, the percentage of fat in the pasteurized milk samples was within the limits of the standard specification for pasteurized milk. Similar results in pasteurized milk were found by both Hossain et al. (2011) and Huque et al., (2018).

Proteins (%)

The results in table (1) showed that there are no significant differences between the milk samples in protein percentage, except for sample S3. The increase in the protein percentage in that sample (4.82%) is due to the possibility of adding skim milk powder, which is evident through the high density of the milk (1.036).

The protein percentages in the rest of the samples ranged between 3.30-3.58, according Hossain et al., (2011), the amount of protein in raw milk ranged between 3.03-3.57%. The results of the study agreed with what was found by Abd Elrahman et al., (2009) in that the protein content in local raw milk was 3.48%. Fikrineh et al. (2012) also reported that the protein content in samples of milk produced on local farms was 3.46%.
The protein percentage in pasteurized milk samples P1 and P2 was 3.56 and 3.60, respectively. These values were consistent with what Karmaker et al., (2020) found in pasteurized milk samples in Bangladesh.

Table 1: Chemical analysis results of raw milk samples.

Samples	Specific gravity (g/cm3)	TS %	pH	Acidity %	Fat %	Proteins %
S1	1.021 a	11.40 a	6.64 a	0.15 c	4.2 a	3.40 a
S2	1.023 a	11.52 a	6.80 a	0.14 d	4.0 a	3.30 a
S3	1.036 a	14.18 b	6.72 a	0.15 d	4.5 a	4.82 b
S4	1.013 a	10.0 c	6.50 a	0.16 c	2.5 b	3.37 a
S5	1.023 a	11.50 a	6. 45 a	0.18 c	3.5 b	3.58 a
S6	1.017 a	11.20 a	6.77 a	0.15d	4 .5 a	3.46 a
S7	1.012 a	9.47 d	6. 56 a	0.16d	1.9 b	3.43 a
S8	1.030 a	12.65 e	6.75 a	0.15 d	4.2 a	3.32 a
S9	1.031 a	12.88 e	6.37 a	0.20 a	4.4 a	3.42 a
S10	1.031 a	12.31 f	6.61 a	0.15 b	4.1 a	3.50 a
P1	1.030	11.48	6.61	0.16	3.5	3.56
P2	1.031	11.46	6.70	0.15	3.6	3.60
ST	1.028-1.032	11-13	6.4-6.8	0.13-0.17	3-5	3.40

S1 – S10: raw milk samples, P1 and P2: pasteurized milk samples, ST: Standard specification. Similar letters in the column of the table mean that there are no significant differences, and different letters mean that there are significant differences at the 5% level.

4. Microbial analysis

Total count of bacteria (TCB)

Raw milk is a good medium for the growth of microorganisms due to its high water content and diversity of nutrients in addition to its close to neutral pH, which makes it one of the best media for the growth and multiplying microbes (Soomro et al., 2002).
The results of the microbial analysis (Table 2) showed that the total count of bacteria in the milk samples was high, ranging between 7.5 x 103 to 2.2 x 107 cfu/ml. The reason for the increase in the total number of bacteria in the milk is due to the poor health conditions during milking, as the increase in the number of bacteria can be due to several reasons, the most important of which are: the animal being infected with mastitis, the animal's udder being dirty, the animal's environment and the milking place being unclean, the milking tools and the milker's hands being unclean and milk don't cooling after milking immediately (Fadaei, 2014). Similar results were obtained by Huque et al., (2018) who indicate the high total number of bacteria in raw milk was between 2.31 x 105 - 2.45 x 105 cfu/ml). also, similar results were found by Iknomov et al., (1956) who stated that the number of bacteria in milk depends on milking and hygiene techniques. On the other hand, pasteurized milk samples showed a decrease in the total count of bacteria, due to the effect of pasteurization and packaging under sterile conditions. Microbial contamination not only reduces the quality of milk, but also threatens the health of the community when consumed this type of milk (El-Leboudy et al., 2017)

Coliform Total (CT)

The presence of coliform bacteria in foods is considered an indicator of the occurrence of some form of unwanted fecal contamination (Saha and Ara 2012). Results in table (2) indicated that 60% of the samples were contaminated with coliform bacteria, as they exceeded the standard limits for this type of bacteria in raw milk (100 cfu/ml), where sample S9 was the highest in the number of coliform bacteria (1.8 x 105 cfu/ml). Similar results were found by Hossain et al., (2011) who reported that the numbers of coliform bacteria in raw milk ranged between 4.5 x 103 and 2.03 x 106 cfu/ml. Poor animal hygiene, contaminated water, unsanitary milking

practices, improper washing of milking equipment and tools, in addition to lack of attention to the cleanliness of the milkers' hands can lead to a high number of coliform bacteria in the raw milk (CDFA, 2008).

While the pasteurized milk samples were free of coliform bacteria, similar results were found by Hossain et al., (2011) and Huque et al., (2018) they reported the absence of coliform bacteria in pasteurized milk. CDFA, (2008) indicated that coliform bacteria are not supposed to be present in milk after pasteurization due to their sensitivity to the pasteurization temperature. If present, it is evidence of contamination after pasteurization.

Yeasts and Molds

Contamination of raw milk with yeasts and molds can occur in the primary production stages (farm and milk equipment) or in the manufacturing environment, and this type of contamination often leads to uncontrolled fermentation in the milk and thus its spoilage (Lavoie and Touchett, 2012).

Results in table (2) indicated that there were significant differences in the numbers of yeasts and molds in the samples, where sample S2 was the lowest in numbers of yeasts and molds (10 cfu/ml), while sample S9 was the most contaminated with yeasts and molds (1.2 x 106 cfu/ml), the study agreed with what Karmen and Vengust, (2008) who found regarding the increase in the number of yeasts and molds in raw milk sold in local markets. Exposure of milk to air for different periods, in addition to the lack of poor hygiene practices during milking and mixing old milk with new milk, can lead to an increase in the number of yeasts and molds in raw milk (Kuma et al., (2015)). On the other hand, the pasteurized milk samples were free of yeasts and molds, as evidence of the efficiency of the pasteurization process and the control of sanitary conditions during manufacturing.

Table 2: Microbial analysis results of raw milk samples

Samples	TCB (cfu/ml)	CT (cfu/ml)	Y & M (cfu/m)
S1	18 $X10^6$	5 $X10^4$	2.5 $x10^5$
S2	7.5 X 10^3	0	0
S3	3.6 X 10^6	2 $X10^4$	10^4
S4	1.5 X 10^7	7 $X10^4$	6.5 $x10^5$
S5	1.6 $X10^6$	0	$1x10^3$
S6	1.1 X 10^6	1.3 X 10^5	3.6 $x10^5$
S7	1.4 $X10^7$	1.6 $X10^5$	1.7 $x10^5$
S8	2 $X10^7$	0	$1.8x10^3$
S9	1.6 $X10^7$	1.8 $X10^5$	$1.2x10^6$
S10	2.2 $X10^7$	1.3 X 10^4	$7.6x10^5$
P1	50	0	0
P2	35	0	0
ST	10^4 good milk 10^5 acceptable milk	100cfu/ml	10^3

S1 – S10: raw milk samples, P1 and P2: pasteurized milk samples, ST: Standard specification.

5. Conclusion

The results of the study showed that most of the samples of raw milk sold in the markets of Hodeidah city were adulterated, either by adding water, adding powdered milk, or removing part of the fat.

The study also showed that the microbial load of the milk was high, especially coliform bacteria, which means there are health risks for this type of milk. While the pasteurized milk samples were within normal limits, chemically and microbially. Therefore, it is necessary to apply health requirements during the milking process, in addition to keeping the milk in refrigerated condition to reduce microbial activity. Boiling the milk before consuming it is considered an important factor in eliminating microbial risks.

Refrencess

[1]. Xulu, N.H., Jamal-Ally, S., & Naidoo, K.D. (2019). Microbial and Chemical Adulterants Assessment of Raw Cow Milk Collected from Dairy Farms of Hlabisa Villages, KwaZulu-Natal Province, South Africa. Journal of Food Quality and Hazards Control 6: 162-167. orcid.org/0000-0002-5320-0538.

[2]. Eckles, C H., Combs, W. B. & Macy, H. (1951). Milk and Milk Products. 4th Edition, p. 23, McGraw-Hill Book Company Inc., New York, Toronto, London.
[3]. FAO (Food and Agriculture Organization of the United Nations).(2008). Milk hygiene in milking, milk production hygiene and udder health. FAO Animal Production and Health Papers-78. FAO Corporate Document Repository. (CDR), p: 1-7.
[4]. Hempen, M., Unger, F., Münstermann, S., Seck, M.T., & Niamy, V.,(2004). The hygienic status of raw and sour milk from smallholder dairy farms and local markets and potential risk for public health in The Gambia, Senegal and Guinea. Animal Health Research Working Paper 3. ITC (International Trypanotolerance Centre), Banjul, The Gambia,p: 54.
[5]. Tola, A., (2002). Traditional milk and milk products handling practices and raw milk quality in eastern Wollega. MSc Thesis. Alemaya University, Ethiopia.
[6]. Awal, M.S., Amin, M.R., Haque, M.R., Kamal, M.M., & Hasan S.M.K.(2016). Evaluation of physico-chemical properties and detection of adulterants of UHT milk samples available in Bangladesh. Int Res J Biol Sci; 5 (2):1–6.
[7]. Aggarwal, A. C., & Sharma, M., (1961). A Laboratory Manual of Milk Inspection. 4th edn., Asia the Publishing House, Bombay, Calcutta, New Delhi, India. P: 14.
[8]. Goss, E. F., (1953). Techniques of dairy testing Ames (lowa). The lowa State College Press, US, p: 350.
[9]. AOAC., (2003). Official Methods of Analysis of the Association of Agricultural Chemists, 17th edn., Washington, USA, 990. P: 19.
[10]. Pearson, D., (1977). The Chemical Analysis of Food. 7th Ed., Chemical Publishers Co., New York, P: 9-11.
[11]. APHA, (American Public Health Association).(1998). Standard Methods for examination of Dairy Products, 20th edn., Washington D.C. USA, p: 144 and 147-148.
[12]. FAO, (Food and Agriculture Organization of the United Nations). 1988. Animal production and health paper. FAO, Rome, Italy.
[13]. Tamime, A.Y., (2009). Milk Processing and Quality Management. Society of Dairy Technology, United Kingdom.
[14]. Gemechu, T., & Tesfaye, A., (2016). Physicochemical Properties and Microbial Quality of Raw Cow Milk Produced by Smallholders in Bench Maji-Zone, Southwestern Ethiopia. Food Science and Quality Management. 54 :47-54.
[15]. Karmaker, A., Pabitra, C., Das, L., & Abdullah, I., (2020). Quality assessment of different commercial and local milk available in the local markets of selected area of Bangladesh). Journal of advanced veterinary and animal research. 7, (1): 26–33. Doi.org/10.5455/javar.2020.g389.
[16]. Gemechu, T., Beyene, F., & Eshetu, M.,(2015). Physical and chemical quality of raw cow's milk produced and marketed in Shashemene Town Southern Ethiopia. J Food Agric Sci; 5(2):7–13.DIO:10.5897/ISABB-JFAS2014.0017.
[17]. Eckles C. H., Combs W. B. and Macy H. (1951). Milk and Milk Products. 4th Edition, p: 23, McGraw-Hill Book Company Inc., New York, Toronto, London.
[18]. Omore, A., Lore T., Staal S., Kutwa J., Ouma R., Arimi S., & Kang'ethe E. (2005). Addressing the public health and quality concerns towards marketed milk in Kenya. Smallholder Dairy Project. Nairobi, Kenya, p: 42.
[19]. O'Connor, C.B., (1995). Rural Dairy Technology ILRI Training Manual I, International Livestock Research Institute, Addis Ababa, Ethiopia.
[20]. Hossain, T. J., Alam, M. K., & Sikdar D. (2011). Chemical and microbiological quality assessment of raw and processed liquid market milks of Bangladesh. Continental J. Food Science and Technology. 5 (2): 6 – 17.
[21]. Zelalem, Y. & Ledin, I. (2001). Efficiency of smallholder butter making in the Ethiopian central highland. Pastoralism and Agropastoralism-which way forward; In: Proceedings of the eighth Annual Conference of the Ethiopian Society of Animal Production 24 - 26 August, 2000, Addis Ababa, Ethiopia. pp.192.

[22]. FAO (Food and Agriculture Organization of the United Nations). 1999. Extension Services for Quality Milk Production. Proceedings of an International Workshop in conjunction with the East-West-Forum of the Federal Ministry for Food, Agriculture and Forestry, Germany. P:35.

[23]. Huque, R., Jolly, Y.N., Choudhury, T.R., Munshi, M. K., Hussain, M. S., Khatun, A., Roy, B.K., Islam, M., Hossain, M.A., & Hossain A.(2018). Evaluation of elemental, microbial and biochemical status of raw and pasteurized cow's milk. International Food Research Journal 25(4): 1682-1690.

[24]. Saxena, M., & Poonam, R., (2013). Microbiological And Chemical Analysis Of Raw, Pasteurized And UHT Milk During Preservation In India. International Journal of Chem Tech Research..5(6): 2804-2809.

[25]. Popescu A. and Angel E. (2009). Analysis of milk quality and its importance for milk processors. Lucrări Ştiinţifice Zootehnie Şi Biotehnologii. 42 (1): 501-503.

[26]. Sraïri, M.T., Moudnib, J., Rahho, L., & Hamama, A. (2006). How do milking conditions affect the hygienic quality of raw milk? Case study from Moroccan dairy farms. Livestock Research for Rural Development. Hassan II Agronomy and Veterinary Medicine Institute. 18. Article 97.

[27]. Samia, M. A., Abd Elrahman, A. M. M., Said, A., Ibtisam, E. M., El Zubeir L., Owani O., & Ahmed, M. K., (2009). microbiological and physicochemical properties of raw milk used for processing pasteurized milk in blue Nile dairy Australian Journal of Basic and Applied Sciences, 3(4): 3433–3437.

[28]. Dey, S., & Karim, M.H., (2013). Study on physicochemical and microbial quality of available raw, pasteurized and UHT milk during preservation. International Journal of Science Inventions Today, 2(2): 150–157.

[29]. Abd Elrahman, S.M., Ahmad, A.M., El Owni, A.O., & Ahmed, M.K., (2009). Microbiological and Physicochemical Properties of Raw Milk Used for Processing Pasteurized Milk in Blue Nile Dairy Company (Sudan). Australian Journal of Basic and Applied Sciences, 3(4): 3433-3437.

[30]. Fikrineh, N., Estefanos, T., Tatek, W.(2012). Microbial quality and chemical composition of raw milk in the Mid-Rift Valley of Ethiopia. African Journal of Agricultural Research, 7(29): 4167-4170. DOI:10.5897/AJAR12.830.

[31]. Saha, S., & Ara, A., (2012). Chemical and Microbiological Evaluation of Pasteurized Milk Available in Sylhet City of Bangladesh. The Agriculturists 10 (2): 104-108.

[32]. CDFA, (2008) New coliform standard for milk sold raw to consumers. California Department of Food and Agriculture. Retrieved July 25, 2010, from http://www.cdfa.ca.gov/AHFSS/Milk_and_Dairy_Food_Safety/pdfs/ColiformStandardMilkConsumedRaw.pdf.

[33]. Oomro, A.H., Arain, M.A., Khaskheli, M., & Bhuto, B. (2002). Isolation of E. colifrom raw milk and milk products in relation to public health sold under market conditions at Tandonjam, Pakistan. J. Nut. 1 (3): 151-152. DOI: 10.3923/pjn.2002.151.152

[34]. El-Leboudy, A., Amr, A., Amer, H., Abo El-Makarem S., & Ibrahim E.K. (2017). Chemical and Microbiological Status of Raw Milk Sold at Local Markets. Alexandria Journal of Veterinary Sciences. Vol. 55 (1): 125-132. DOI:10.5455/ajvs.281717.

[35]. Fadaei, A. (2014). Bacteriological quality of raw cow milk in Shahrekord, Iran. Vet. World 7 (4): 240-243. Doi: 10.14202/vetworld.2014.240-243.

[36]. Ikonomov, L., Lotov, I., Todorov, D., Tankov, G. & Dzhurov, T.S. (1956). Bacteriological studies of Hygiene of milk production of Bulgarian cattle Breeding Farms. Dairy Science Abstract 19: 936.

[37]. Lavoie, K., Marilyne T., Daniel S., & Steve L. (2012). Characterization of the fungal microflora in raw milk and specialty cheeses of the province of Quebec. Dairy Sci. & Technol.92:455–468. DOI 10.1007/s13594-011-0051-4.

[38]. Karmen, G.T. & Vengust, A. (2008). The presence of yeasts, moulds and aflatoxin M1 in raw milk and cheese in Slovenia. Food Control 19(6):570-577. Doi.org/10.1016/j.foodcont.2007.06.008

[39]. Kuma, A., Degefa T., & Melese A. (2015). Assessment of Raw Milk Microbial Quality at Different Critical Points of Oromia to Milk Retail Centers in Addis Ababa. Food Science and Quality Management.38: 1-9.