Detection of the Adulterations Methods Used for the Fresh Cow Raw Milk at the Main Market at Bor Town (Marol Market) Jonglei State

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Abstract

The present study was conducted at Bor town, Jonglei state. The aim of this study was to detect and determine the common methods used by traders and milk dealers in the adulation of fresh raw cow milk samples before selling it to the consumers at the main market. Thirty samples of fresh cow raw milk were collected randomly from the main local market in the town of Bor, and the samples were subjected to further analysis; the collection of samples lasted for thirty days, with an average collection of only one sample per day. The final results from this study concluded that starch was the main adulterant which was used for cow milk adulteration rather than water and other methods of adulteration. The economic crisis forced milk dealers and sellers to add adulterants, such as water, starch, etc., into the milk in order to increase the quantity of milk to get more profit.

Keywords: Fresh Cow Raw Milk, Adulteration, Starch, Water

1. Introduction

Milk is defined as a normal secretion of the mammary glands of mammals and cannot be colostrum's or colostrum's-like milk (Clarence *et al*.,2004). Cattle Milk can also be defined as the original milk of one or more cows, which has not been heated to more than 40^{o}C (Original temperature) and has not been submitted to any kind of treatment (Edddgar & Axel, 1995). It is obtained by simple or multiple milking of cows that are kept for the purpose of milk production. Milk is a good source of nutrients and edible energy (Femema. *et al.*, 1985). Milk has been an important part of the human diet as far back as 6000 years (Payne, 1990).

Milk is secreted by the mammary glands of mammals to feed their young ones, and it is the sole source of nutrients for the youngest mammals for the length of time which varies with the species (O'Connor, 1995). Normal milk consists of about 13 to 14 per cent total solids, 86 to 87 per cent water and 3 to 6 per cent butter fat. Good milk has a rich flavour and very little odour. It must not appear dirty, discoloured or watered down and must be free of diseases (Thomas, 1980). It is also an excellent source of minerals and supplies virtually all the minerals required by humans. The high levels of calcium and phosphorus in milk are important in bone and tooth formation in young children and, therefore, help in preventing osteoporosis in elderly people (O'Connor, 1995).

As stated by Anita (2001), milk and milk products provide a significant amount of protein, macro and micro-nutrients and B vitamins. The milk can be used by consumers from different animals such as cows, goats, sheep, mares and reindeer (Kordylas, 1990).

Edgar and Axel (1995) stated that good milk quality is the basis for the production of high-quality products. According to Barmley and Mckinnon (1990), milk from farms may be contaminated with different bacteria present in the cow and its environment, including contaminated water used to clean the milking system.

The nutritive value of milk may be considerably altered by processes such as separation, concentration of components, addition of non-milk constituents and heat treatment (O'Connor, 1995).

1.1. Research objectives

The main objective of this study is to find out the rate of milk adulteration at the main Market in Bor town (Marol market), Jonglei state. However, the following are other specific objectives:

i. To identify and study the various adulterants used in milk adulteration.
ii. To find out the most commonly used method of milk adulteration.
iii. To find some suitable solutions for milk adulteration around the area.
iv. To study the ways of detecting milk adulteration and to reduce the danger coming from milk adulteration

1.2 Research questions

The main question of this research is what the effect of adulteration is on the final quality of the milk.

2. Literature Review

2.1 Common methods of milk adulteration and their detection

Milk adulteration is an act of intentionally reducing the quality of milk offered for sale, either by substitution or removal of valuable ingredients (Ravindra, 1993). Milk dealers may either dilute the milk or extract the valuable compounds and, therefore, add compositional parameters such as starch, urea, hydrogen peroxides, boric acid and various antibiotics (Tipu *et al.,* 2007). Adulterated food is dangerous for health as it contains toxic chemicals that deprive the human body of nutrients for proper growth and development (Awan *et al*., 2013).

Urea: This is added to increase the non-protein nitrogen content of milk. The presence of urea is detected using paradimethylaminobenzaldehyde (p-DMAB). Urea reacts with P-DMAB to form a yellow complex in a low acidic solution at room temperature (Sharma *et al*., 2012).

Hydrogen peroxide: It acts as a preservative and increases the shelf life of the milk.

Detection: Vanadium peroxide is dissolved in sulphuric acid and put in milk.

The appearance of pink or red indicates the presence of hydrogen peroxide in milk.

(A.O.A.C., 2009).

Detergents: These are added to emulsify and dissolve oil in water, giving a frothy solution, which is the desired characteristic of the milk. Detection: The use of methylene blue dye and chloroform detect the presence of detergents (Singuluri & Sukumaran, 2014).

Sodium chloride: The addition of sodium chloride in milk increases solid-non-fat. Detection: The use of silver nitrate and potassium chromate reagents detect sodium chloride (Technews, 2009).

Ammonium sulfate is added to milk to increase lactometer readings by maintaining the density of diluted milk. Detection: Nessler's reagent test detects the presence of ammonium sulfate (Sharma *et al..*, 2012).

Boric acid and Borates Are added to milk for preservation purposes. Detection: Use of Tumericpaper, concentrated Hydrochloric acid, Ammonium hydroxide and caustic soda can detect the presence of Boric and Borates (Technews, 2009).

Cellulose: To increase total solids and hence the quantity of the products.

Detection: The use of Iodine-zinc chloride detects the presence of cellulose in milk (Technews, 2009).

Salicylic acid: It is used for the preservation of milk. Detection: The use of dilute hydrochloric acid, ether, and 0.5 %(v/v) neutral ferric chloride solution (Sharma *et al*., 2012).

Starch: The addition of starch into milk increases the solid –Non-fat content.

Detection: An iodine test detects the presence of starch in milk (Technews, 2009).

Water: This is added to increase the volume of milk, which in turn decreases its nutritive value. Detection: Use of Nitrate test and Lactometer test to detect the presence of water in milk (Singuluri & Sukumaran, 2014).

2.2 Factors affecting the chemical composition of cow milk

Milk composition is affected by various factors such as the stage of lactation, breed differences, feeds, and the health of the animal.

Animal feed: Milk can be modified to improve its nutritional value and sensory quality by changing the animal diet (Mesfin & Getachew, 2007; Castagnetti *et al*., 2008). Supplements such as organic selenium may increase proteins in milk (Walker *et al*., 2004).

Lactation stage: The milk of wild and semi-domesticated ruminants is richer in both protein and fat in late lactation than in the early stage (Holand *et al*., 2006). In contrast, some mares and donkey breeds have been reported to produce relatively dilute milk in mid to late lactation (Ramljak *et al.*, 2009).

Breed of the animal: Milk composition varies considerably among breeds of dairy cattle. Holstein and Brown Swiss produce milk that contains about 3.5% fat. But Guernsey and Jersey give milk that contains 5% fat (Jensen & Robert, 1995).

Health of the animals: The presence of pathogenic bacteria in the udder decreases milk yield and increases leucocytes and somatic cell count. Cows suffering from clinical mastitis produce milk lower in lactose and potassium but higher in sodium and chloride than normal milk (Haenlein, 2006).

Age and body weight: Increased number of lactation results in a gradual decrease in milk fat and solid-non-fat. The drop in milk fat content is about 0.2% from the first to fifth lactation and 0.4%solids-non-fat (Haenlein, 2006).

Feeding regime:

Underfeeding reduces both the fat and the Solid-Non-Fat content of milk. Fat content and fat composition are influenced more by roughage fibre intake. Solid-non-fat content falls if the cow is fed a low-energy diet (O, Connor, 1995).

Physiological condition: The condition of the cow at the time of parturition has an effect on fat and solid-non-fat content. Healthy cows give high-fat and solid-non-fat (Sri. and Krishnaiah, 2005).

Milking interval: When milking is done at a longer interval, the yield is higher, with a corresponding decrease in fat and vice versa (Sri & Krishnaiah, 2005).

3. Material and Methods

This study was conducted at the laboratory of Dr. John Garang Memorial University of Science and Technology, Bor Town, Jonglei State.

3.1. Materials

Source of milk

Thirty samples of fresh cow raw milk were collected from different locations from the main market in Bor town (Marol market), Bor, Jonglei state, and were taken immediately for test and analysis. A Lactometer, sheet of glass, water, towel, 800ml beaker, 1000ml measuring cylinder and cello tape were assembled in the laboratory**.**

3.2. Methods

Lactometer test

Each sample (bottle) containing milk was marked with a number and poured into an 800ml beaker, then finally into a 1000ml measuring cylinder.

A lactometer was inserted into the milk and allowed to settle for 1 minute.

Reading was taken and recorded three times for each bottle per day until all bottles were completed.

Use of glass

2-3 drops from each sample were poured on a slanted sheet of glass and allowed to move slowly while being observed. This process is repeated for all 30 samples.

4. Results

The normal lactometer reading for the normal fresh raw cow milk is (1.028 -1.032 g/ml). If water has been added, the lactometer reading will be below 1.028 g/ml, and if any solid, like starch, has been added, the reading will be above 1.032 g/ml.

The results of 30 samples of fresh cow raw milk tested and analyzed with the help of the lactometer and glass sheet are shown in Table 1 below:

S/No	Samples No.	Sample Analysis	Mean	Remark
1.	One	S1.1=1.033 S1.2=1.033 S1.3=1.034	1.033	Cheated
2.	Two	S2.1=1.032 S2.2=1.032 S2.3=1.032	1.032	Normal
3.	Three	S3.1=1.031 S3.2=1.030 S3.3=1.030	1.030	Normal
4.	Four	S4.1=1.030 S4.2=1.030 S4.3=1.030	1.030	Normal
5.	Five	S5.1=1.030 S5.2=1.031 S5.3=1.031	1.031	Normal
6.	Six	S6.1=1.031 S6.2=1.030 S6.3=1.031	1.031	Normal
7.	Seven	S7.1=1.030 S7.2=1.030 S7.3=1.030	1.030	Normal
8.	Eight	S8.1=1.032 S8.2=1.030 S8.3=1.031	1.031	Normal
9.	Nine	S9.1=1.031 S9.2=1.030 S9.3=1.030	1.030	Normal
10.	Ten	S10.1=1.032 S10.2=1.030 S10.3=1.030	1.030	Normal

S/No	Samples No.	Sample Analysis	Mean	Remark
11.	Elven	S11.1=1.033 S11.2=1.033 S11.3=1.034	1.033	Cheated
12.	Twelve	S12.1=1.034 S12.2=1.034 S12.3=1.035	1.034	Cheated
13.	Thirteen	S13.1=1.034 S13.2=1.034 S13.3=1.035	1.034	Cheated
14	Fourteen	S14.1=1.030 S14.2=1.030 S14.3=1.030	1.030	Normal
15.	Fifteen	S15.1=1.031 S15.2=1.031 S15.3=1.032	1.031	Normal
16.	Sixteen	S16.1=1.030 S16.2=1.031 S16.3=1.032	1.031	Normal
17.	Seventeen	S17.1=1.032 S17.2=1.032 S17.3=1.032	1.032	Normal
18.	Eighteen	S18.1=1.033 S18.2=1.033 S18.3=1.034	1.033	Cheated
19.	Nineteen	S19.1=1.031 S19.2=1.031 S19.3=1.031	1.031	Normal
20.	Twenty	S20.1=1.034 S20.2=1.035 S20.3=1.035	1.035	Cheated
21.	Twenty one	S21.1=1.035	1.035	Cheated

S/No	Samples No.	Sample Analysis	Mean	Remark
		S21.2=1.035 S21.3=1.035		
22.	Twenty two	S22.1=1.032 S22.2=1.033 S22.3=1.033	1.033	Cheated
23.	Twenty three	S23.1=1.030 S23.2=1.030 S23.3=1.032	1.030	Normal
24.	Twenty four	S24.1=1.030 S24.2=1.031 S24.3=1.030	1.030	Normal
25.	Twenty five	S25.1=1.032 S25.2=1.032 S25.3=1.030	1.031	Normal
26.	Twenty six	S26.1=1.033 S26.2=1.032 S26.3=1.030	1.032	Normal
27.	Twenty seven	S27.1=1.030 S27.2=1.035 S27.3=1.030	1.032	Normal
28.	Twenty eight	S28.1=1.030 S28.2=1.032 S28.3=1.030	1.031	Normal
29.	Twenty nine	S29.1=1.034 S29.2=1.034 S29.3=1.035	1.034	Cheated
30.	Thirty	S30.1=1.036 S30.2=1.035 S30.3=1.035	1.035	Cheated

*Note: The normal lactometer reading for the normal cow milk is (1.028 -1.032g/ml).

** The milk sample from the university dairy farm at Dr. John Garang Memorial University of Science and Technology was used as the indicator sample, which is free from cheating.

5. Discussion

According to the results obtained in Table 1, the commonly used method for adulteration was starch. In samples 1, 11, 12, 13, 18, 20, 21, 22, 29, 30, starch was added.

On the same note, much starch was added in samples 20, 21 and 30 with a specific gravity of 1.035g/ml.

But in samples 1, 11, 18, and 22, little starch was added (specific gravity 1.033g/ml).

On the other hand, samples 2-10, 14-17,19, and 23-28 were not cheated with either water or starch.

According to the results obtained, starch was the main adulterant rather than water. This was in agreement with a study done by Ahmed (2009) in Khartoum state on the addition of water and starch to milk, and it concluded that starch was commonly used rather than water.

The milk sellers at Marol market added starch along with water into the milk in order to increase the quantity and get more profits. Similar results were reported by Ghulam *et al*. (2014), who found that the addition of starch was to increase the quantity of milk. The milk sellers used starch because of its cheaper prices compared to other adulterants. This was in line with the research conducted by Ahmed. (2009) on the addition of starch to milk in Khartoum state and reported that starch was used because it was not expensive.

They also added any available starch, whether contaminated or not. This was in agreement with the results obtained by Ahmed **(**2009**)**, who reported that the milk dealers in Khartoum state added any available starch without consideration for the health of the consumers.

These results were not in line with those of Al Fathi (2009), who collected 30 samples of raw milk from Sharg Elneil and Alsalama in Khartoum State in 2009, and he concluded that the testing for the starch was negative for all locations. The milk sellers at Marol market added starch to milk in order to increase the quantity and get more profits. Similar results were reported by (Ghulam *et al*., 2014).

The other methods of Milk Adulteration, such as adding Sodium chloride, Ammonium sulfate, Cellulose, Boric acid and Borates, Hydrogen peroxide etc., are not known by the milk dealers and sealers at the main market, and some of the dealers and sellers are not even familiar with such methods of adulteration that why it was not covered in this study.

6. Conclusions

The primary objective of the producers, processors and retailers of milk and milk products is to provide the consumer with products of unquestionable quality. Milk of high grade must be clean and of good flavour, contain a minimum of contaminants and be free from adulterations and any strange materials.

From the results obtained, the following conclusions can be given:

1. Starch was the commonly used method for adulteration at the Marol market.

2. The addition of starch in fresh cow milk was to increase the quantity in order to get profits.

3. The milk dealers added starch without any consideration for health, whether contaminated or not.

4. Starch was used because of its lower price, colour, and ability to dissolve in milk.

7. Recommendations

1. Milk for sale should be tested by public health officials before being allowed to the markets.

2. Laws should be made to punish those who may practice milk adulteration.

3. The milk dealers should be enlightened about the health effects associated with the consumption of adulterated milk and milk products.

4. Spoiled milk should be disposed of if found.

5. Milk dealers should be advised to use clean milk containers to avoid contamination.

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