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Effect of seasonal variation on chemical composition of Cow's milk

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A B S T R A C T

The main objective of this study were to identify the chemical composition of cow's milk produced in Menofiya governorate and determine the effect of seasonal variation on the main components of raw cow's milk along a year in Egypt with special database for Menofiya raw cow's milk composition. A total of 100 random cow milk samples were collected from different farms and supermarkets in Menofaya governorate during different seasons [winter-spring-summer and autumn]. Our results showed that the mean values of fat, T.S., protein, and moisture in winter for cow's milk were 3.6 ± 0.055 , 12.4 ± 0.071 , 3.5 ± 0.046 and 85.5 ± 0.075, respectively, and in summer were 3.1 ± 0.058 , 11.1 ±0.092 , 3.1 ±0.060 and 88.8±0.092 , respectively. From this study we concluded that the major components of milk (moisture, fat, protein and total solids) are affected by seasonal changes.

Keywords: Seasonal variation; Cow's milk; chemical components

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1. INTRODUCTION

Milk and dairy products are important components of Egyptian diets. The composition of raw milk determinates to large extent the nutritional value and the technological properties of milk and dairy products. The composition of milk is of great importance for dairy industry and there is great interest in changing the composition of milk (Fox and McSweeney 1998). Milk is very important due to its special nutritive value and important role for human and animal health. It has all the substances needed by organisms in its easiest assailable form. It has high value proteins (casein, lactalbumin and lactoglobulin providing essential amino acids) , fat providing energy (9.3 kcal /g), a low melting point (29-34 °C) , small globules stimulating an easy assimilation, A and D that playing an special role in Calcium and Phosphorus fixation in bones , as well as level compared to other foods of animal origin Popescu and Angel (2009). Milk contains a wide array of proteins with biological activities ranging from antimicrobial ones to those facilitating absorption of nutrients, as well as acting as growth factors, hormones, enzymes, antibodies and immune stimulants Korhonen, H. et al., (1998). Milk contains a wide array of proteins with biological activities ranging from antimicrobial ones to those facilitating absorption of nutrients, as well as acting as growth factors, hormones, enzymes, antibodies and immune stimulants (Korhonen, H. et al., 1998). The production of cow milk and dairy products have greatly grown to appeal to consumers looking for differentiated nutritional and functional quality besides special characteristic and taste (Araujo et al., 2012). As cow's milk has

lactose, protein, and Ca, Fe and P as well as vitamins A, C and B complex. (Abd El – Salam and El-Shibiny 2011; Araujo et al., 2012; Medhammar et al., 2012; Abd El – Salam and El-Shibiny 2013). Many factors influence the composition of milk; the major components are water, fat, protein, lactose and minerals, Nutrition or dietary influences readily fat and milk protein concentration. Fat is the most sensitive to dietary changes and can vary over a range of nearly 3.0 percentage units. Dietary manipulation results in milk protein concentration changes to approximately 0.60 percentage units. The ratio of lactose and minerals, the other solids constituents of milk, do not respond predictably to adjustments in diet (Looper, 1994). Seasonal variation influences the quality of milk and milk products depending on its composition which in turn varies including to lactation stage, location, breed and species, milk system, animal age and size, environment, climate, temperature and diet composition thus influence the quality of milk products (Galvao et al., 2010). Hence cow milk production and composition can be directly influence by the season as it affects feed availability (Bastianetto et al., 2005). There is inverse relationship between milk yield and component percentages, with summer milk production being higher but percentages of fat and protein being lower compared with production in the fall and winter months Quist et al. (2008). The percentages of fat and protein have been influenced by the seasonal variations. The light-to-dark ratio can also induce marked changes in milk yield and composition. In fact, a high light-to-dark ratio leads to a reduction in fat and protein contents of milk, probably as a consequence of a greater secretion of prolactin whose concentration in plasma is higher in the summer than in the winter. Lactation period moved forward progressing and when the environmental heat degree increased, the fat content decreased. By Ozrenk,E and Inci, S.S. (2008). Towards the beginning and the end of lactation period the protein and fat concentrations tend to increased compared with the middle period due to the great effect of seasonal variation on milk composition Banasal, B., et al (2009). The main object of this study was to investigate the effect of seasonal variation in the main components of raw cow's milk along a year in Menofiya governorate, Egypt to provide database for such results.

2. MATERIALS AND METHODS

2.1. Collection of samples:

A total of 100 random cow milk samples were collected from different farms and supermarkets in Menofaya governorate during different seasons [winter-spring-summer and autumn] (25 of each).
All collected samples were transferred directly in an ice –box to the laboratory without of delay for determination of their chemical composition.

2.2. Determination of fat%:

It was carried out using Gerber method (Van den Berg, 1988).

2.3. Determination of Total solids:

It was carried out using Gravimetric method (O'Connor, 1994).
Total solids %= Weight of residue/ Weight of milk sample x 100.

2.4. Determination of protein%:

It was carried out using Kjeldahl method, the technique was carried out for determination of Protein % by Kjeldahl method depending on collaborative studies which were presented to the Association of Official Analytical Chemists (AOAC, 1990).

2.5. Determination of moisture content:

It was based on Association of Official Analytical Chemists (AOAC, 1990).

3. RESULTS

Milk contains a wide range of proteins with biological activities ranging from antimicrobial ones to those facilitating absorption of some nutrients, as well as acting as growth factors, hormones, enzymes, antibodies and immune stimulants (Korhonen, et al., 1998). Seasonal variation affects milk composition is associated with several factors and Nutritional factors associated with changing availability and quality of pasture through the year, physiological changes associated with the stage of lactation and pathological factors associated with clinical and sub clinical mastitis.

Table 1: effect of seasonal variation on fat content of cow's raw milk

Season	Min.	Max	Mean ±S.E
winter	3.2	4.2	3.6 ± 0.055
spring	2.8	3.6	3.27±0.053
summer	2.6	3.5	3.1 ±0.058
Autumn	3.1	3.8	3.4 ± 0.049

Table 2: effect of seasonal variation on total solids content of cow's raw milk

Season	Min.	Max	Mean ±S.E
winter	11.8	13.0	12.4 ± 0.071
spring	11.1	12.2	11.5±0.073
summer	10.4	11.9	11.1 ±0.092
Autumn	11.7	12.6	12.1 ± 0.055

Table 3: effect of seasonal variation on protein content of cow's raw milk

Season	Min.	Max	Mean ±S.E
winter	3.2	3.9	3.5 ± 0.046
spring	2.7	3.4	3.0. ±0.045
summer	2.5	3.5	3.1 ±0.060
Autumn	2.9	3.8	3.35 ± 0.063

Table 4: effect of seasonal variation on moisture content of cow's raw milk

Season	Min.	Max	Mean ±S.E
winter	83.2	87.0	85.5 ± 0.075
spring	87.8	89.0	88.4 ±0.073
summer	88.1	89.5	88.8 ±0.092
Autumn	87.4	88.4	87.8 ± 0.055

SE = standard Error

4. DISCUSSION

Milk is the best source of nutrition and an article of daily diet, easily accepted and consumed by all age group in rural as well as in urban areas. It provide appreciable amount of fats and protein and also provides body building vitamins along with furnishing energy giving lactose and many other nutrients, therefore an ideal food for pregnant female and infants. Milk can provide a wide range of readily available nutrients to maintain health and normal growth of body. Table (1) showed the mean value of fat % in four seasons (winter, spring, summer and autumn) are 3.6 ± 0.055, 3.27±0.053, 3.1 ±0.058 and 3.4 ± 0.049, respectively. Its level was lower in summer season comparing to any other season but winter showed the highest amount of milk fat. These results agreed with Ayub et al., **(**2007). These differences between summer and winter may be attributed to long days result in a lower fat concentration and reduced rate secretion of fat. As far as is known, climatic conditions and seasonal changes have influences on the milk composition. The fat is the most variable parameter among the major milk components and its synthesis is affected by many factors-especially dietary and environmental factors (Bayril et al., 2010). When temperature is increased the milk fat begins to decrease .Since milk fat synthesis depends on the supply of acetate from the rumen, any feeding regime, such as high grain feeding which lowers the production of rumen acetate, will also lower the fat content of milk during summer season (Yildirim and Cimen, 2009). Table (2) showed the mean value of total solid % in four seasons were 12.4 ± 0.071, 11.5±0.073, 11.1 ±0.092 and 12.1 ± 0.055, respectively. Milk total solid % was higher in winter than summer. These results agreed with the results obtained by Auldist et al., 1998 and Ayub et al., (2007).

Table (3) showed the mean value of protein % in four seasons were 3.5 ± 0.046, 3.0 ±0.045, 3.1 ±0.060 and 3.35 ± 0.063,

respectively. Milk Protein was higher in winter than summer these results are lower by Ayub et al., (2007). The higher milk protein in winter could be attributed to the diet containing high digestible protein content from the green feed (Birssem) and concentrate feed, whereas the feeding in summer gave the lowest milk protein where the diet contained low supplier for protein such as maize silage and rice straw. In this respect, Colombari et al. (1999) attributed the decrease in milk protein to inadequate intestinal absorbed protein, which in turn could be due to very limited rumen undegradable protein content in the diet and to an excess of soluble nitrogen. Table (4) showed the mean value of moisture % in four seasons were 85.5 ± 0.075, 88.4 ±0.073, 88.8 ±0.092 and 87.8 ± 0.055, respectively. Milk moisture was lower in winter than summer these results are similar to the results recorded by Ayub et al., (2007).

Conclusion: the major components of cow's milk (fat, total solids, protein and moisture) are affected by seasonal changes T.S. %, fat % and protein % were higher in winter but lower in summer. The composition of milk was affected by seasonal variation and environmental Factors. The following suggestions must be put in consideration in order to improve milk quality including:- Raw milk should be produced from healthy animals, proper cleaning of animals udder and teats before milking and washing and sanitizing of all dairy utensils and equipments , periodical examination of dairy animal to control diseases and feeding is good by some green foods in summer and autumn to maintain milk components percentage especially fat.

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