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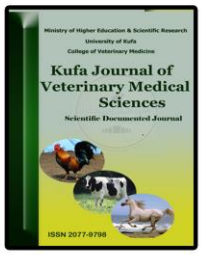

Concentrations of Major and Minor Elements in Cow's Milk at Najaf Province

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Abstract

Milk is a very important human nutritive since their consumption has increased in recent years. The aim of this paper was to determine the content of major and minor elements in different milk samples. The current study included measuring the percentages of fat, protein, lactose and solids non fat. Also the present study involved determination some essential minerals in milk, such as measured concentration of calcium, magnesium, phosphorus, sodium, potassium, chloride, and iron. Milk was sampled in March 2016 on ten farms in the Najaf Province directly into plastic bottles (to avoid contamination). The reported data showed that the essential contents of milk of selected farms were have a significant difference and $P > 0.05$

Keywords: Cow's Milk, Milk Contents, Milk Minerals

الخلاصة:

الحليب هواحد المغذيات المهمة للانسان نظرا لاستهلاكها اليومي و قد ازداد هذا الاستهلاك في السنوات الأخيرة. ان الهدف من هذه الدراسة هو تحديد محتوى المكونات الاساسية والثانوية في حليب الابقار ومن مزارع مختلفة. وشملت الدراسة قياس نسبة الدهون، البروتين، اللاكتوز والمواد الصلبة غير الدهنية. كما شملت الدراسة الحالية أيضا تحديد بعض المعادن الأساسية في الحليب، مثل تركيز الكالسيوم والمغنيسيوم والفوسفور والصوديوم والبوتاسيوم والكلوريد، والحديد. تم أخذ عينات الحليب في الشهر الثالث من عام 2016 ومن عشرة مزارع في محافظة النجف الاشرف وتم وضعها مباشرة في زجاجات من البلاستيك (لتجنب التلوث). وأظهرت البيانات أن محتويات الحليب الأساسية من المزارع المختارة كانت لديها فرق كبير ($P> 0.05$) وفقا للطريقة الاحصائية أنوفا SPSS كما اضهرت النتائج ان هناك تقارب للنسب في مكونات الحليب لبعض المزارع ($P <0.05$)

الكلمات المفتاحية:حليب البقر, مكونات الحليب, معادن الحليب

Introduction

Milk and dairy products are composed of macronutrients (proteins, lipids and sugars) contributing to their nutritional and biological values. They contain also micronutrients like minerals and vitamins. These minerals and vitamins, which are quantitatively minor compounds, are not sources of energy but are essential for the life because they contribute to multiple and different vital functions in the organism, like bone structure, homeostasis, muscular contraction, metabolism via the enzymatic systems, etc. The mineral fraction of milk (approximately 8–9 g/l) is composed of macroelements (Ca, Mg, Na, K, P and Cl) and oligoelements (Fe, Cu, Zn and Se)[1, 2]. Macroelements are differently distributed in the aqueous and micellar phase of milk, depending of their nature. The monovalent cations, Na+ and K+, are present mainly in the free form and only to a limited extent in the form of ion pairs. The divalent cations, Ca^{2+} and Mg^{2+}, play the role in the physicochemical properties of casein

micelles, such as gelation induced by acid and rennet, heat stability, ethanol stability and sediment formation [3]. It is an outstanding source of calcium and as an essential element in the amounts of magnesium, zinc, iron and copper [4,5] . Calcium contributes to structural functions in bones and teeth alongwith regulating many biological functions. More recently, focus on calcium has centered on its role in preventing osteoporosis [6] . Magnesium is the fourth most abundant cation in the human body after sodium, potassium and calcium. Most of the magnesium in the body is deposited in bones [7] .The understanding of milk magnesium composition is important for nutritional management during early life[1]. Sodium is present mostly as an extracellular constituent and maintains the osmotic pressure of the extracellular fluid. Milk is not a rich source of sodium, so that the contribution of milk and dairy products to the intake of sodium is modest. Potassium is most common cation in the intracellular fluid. It regulates the osmotic pressure within the cell and is involved in cell membrane transport and also in the activation of a number of glycolytic and respiratory enzymes[7]. Iron is the most abundant transition metal in the living system and serves more biological roles than any other metal. Iron deficiency affects about 30% of the world population and is one of the main deficiency disorders in Europe[9]. Milk is an ideal food. It has high nutritive value, containing all twenty one standard amino acid that supplies body, building proteins, bone forming minerals and health giving vitamins and furnishes energy giving lactose and milk fat. Besides supplying certain essential fatty acids, it contains the above nutrients in an easily digestible and assimilable form[8,1]. Lactose is the major disaccharide found in milk products and is catabolized into glucose and galactose by the enzyme lactase. Lactose-intolerant individuals have alactase deficiency; therefore, lactose is not completely catabolized. While lactose intolerance is not a dangerous condition, its global prevalence has created a large market for lactose-free products. Commercially available lactosefree products are produced by breaking down lactose into glucose and galactose by enzymatic hydrolysis. Lactulose levels in milk can be used to determine the method that was used to sterilize the milk. The average lactulose content when using in-container sterilization is 744 mg/L, but only 3.5 mg/L in milk treated by low temperature pasteurization methods [10].

Materials

1- The samples of milk were taken from 46 cows with age (3-5 year) at Najaf province
2- Materials of Procedures (sodium hydroxide, hydroxy naphthol powder indicator, EDTA, Eriochrome Black T, sulfuric acid, ascorbic acid, HNO_3, H_2O_2, ammonium molybdate-antimony potassium tartrate)

Methods

1- Milk Component Analysis

for milk component analysis, Eko-Milk analyzer of milk samples was used for determination percentage of fat, protein, lactose and solid non fat.

2- Determination of Calcium:

2 ml of milk sample was mixed with 10 drops of sodium hydroxide (0.1), then added 5 drops of hydroxy naphthol powder indicator then titrated with 0.01N of EDTA.[13]

3- Determination of Magnesium:

2 ml of milk sample was mixed with 4 drops of Eriochrome Black T then titrated with 0.01N of EDTA. The result includes concentration of Calcium and Magnesium. [13]

4- Determination of phosphorus

50 mL of sample and/or standards was mixed with 1 mL of 11 N sulfuric acid and 4 mL of reagent (ammonium molybdate-antimony potassium tartrate) then 2 mL of ascorbic acid solution was added. After 5 minutes, measure the absorbance at 340 nm with a spectrophotometer and determine the phosphorus concentration from the standard curve.[15]

5- Determination of Sodium and potassium:

Iron was determined by flame photometer after treatment of milk with(65% of HNO_3+30% H_2O_2), and determine the Sodium and potassium concentration from the standard curve.[14]

6- Determination of Chloride:

2 ml of milk sample was mixed with 10 drops of potassium chromate (10%), then titrated with 0.01N of silver nitrate.[13]

7- Determination of Iron:

Iron was determined by atomic absorption spectrometer after treatment of milk with(65% of HNO_3+30% H_2O_2). [16]

Statistics

Table (1) Essential composition of raw cow's milk from different Farms

No of Farm/No of Cow	Milk composition			
	Fat%	SNF%	Protein%	Lactose%
1/5	2.85±0.06 AB	8.55±0.05 F	3.22±0.06 BC	4.72±0.01 F
2/5	3.54±0.07 D	8.83±0.05 G	3.46±0.12 CD	4.52±0.01 E
3/5	3.06±0.04 C	7.76±0.01 D	2.94±0.03 A	4.25±0.003 B
4/5	4.82±0.04 G	7.32±0.02 B	2.91±0.01 A	4.1±0.01 A
5/5	3.03±0.02 BC	7.94±0.09 D	3.5±0.05 DE	4.12±0.008 A
6/3	3.22±0.06 C	6.91±0.05 A	3.33±0.05 C	4.15±0.01 A
7/4	4.32±0.17 F	7.88±0.09 D	3.12±0.01 B	4.45±0.005 A
8/5	4.01±0.01 E	8.44±0.05 F	3.61±0.02 E	4.24±0.02 D
9/4	3.14±0.02 C	7.53±0.01 C	2.87±0.01 A	4.36±0.01 B
10/5	2.72±0.02 A	8.11±0.03 E	3.14±0.01 B	4.84±0.01 C

Table 2. mineral levels in raw cow's milk. Means with the same letter are not significantly different.

No of Farm/No of Cow	Ca(mM)	Mg(mM)	P(mM)	Na(mM)	K(mM)	Cl(mM)	Fe(mM) $*10^{-2}$
1/5	23±0.57	16±0.28	69±0.32	6.6±0.05	9.4±0.23	52±0.57	3±0.17

	BC	ABC	E	AB	BC	BC	AB
2/5	19±0.57 A	19±1.73 DE	71±0.20 G	6.4±0.11 A	8.9±0.05 AB	55±0.57 D	2.9±0.07 A
3/5	21±1.15 AB	19±0.18 E	70±0.38 EG	6.6±0.26 A	9.1±0.05 BC	47±0.15 A	3.3±0.17 BC
4/5	19±0.57 A	16±0.58 ABC	65±0.29 F	7.1±0.12 BC	9.6±0.05 CD	53±0.22 C	3.3±0.05 C
5/5	27±1.15 D	15±0.32 AB	57±0.49 B	6.8±0.05 AB	10.1±0.2 1 E	51±0.13 B	3.4±0.20 C
6/3	24±0.57 BCD	18±0.49CDE	61±0.47 D	6.5±0.12 A	9.5±0.09 BCD	47±0.25 A	3.1±0.03 ABC
7/4	26±1.15 CD	14±0.24 A	59±0.47 C	6.9±0.08 BC	9.2±0.11 BC	56±0.57 D	3.5±0.05 C
8/5	18±0.57 A	18±0.52CDE	53±0.47 A	7.3±0.17 C	10.3±0.2 6E	51±0.08 B	3.1±0.08 ABC
9/4	18±1.15 A	15±0.24 AB	73±0.41 H	6.9±0.16 ABC	8.9±0.26 A	48±0.60 A	3.2±0.05 B C
10/5	25±1.73 CD	17±0.49 BCD	61±0.72 D	7.1±0.14 BC	9.8±0.05 D	55±0.63 D	3.3±0.05 C

-mean± SE

-Capital letters denote differences between groups, P<0.05 .

- Similar letters means there isn't a significant difference.

Result and discussion

In this study the cows on the farms were of the same breed, samples were taken in a relatively short period, selected farms was feed the cows same food. Results obtained from Eko-Milk analyzer of milk samples showed in *(Table 1).* The results showed the chemical composition of milk, which is an important indicator because it directly correlated with the good quality of milk. Several studies have reported the distribution and occurrence of the essential components in various kinds of milks[11]. The reported data showed that the essential contents of milk of selected farms were have a significant difference and P > 0.05 According to perform a One-Way ANOVA in SPSS Statistics with convergent results to some farm (P < 0.05). Fat is one of the most important components of milk that affect the price of milk, the nutritional component, or physical and sensory characteristics of dairy products. So fat accounts for approximately 50 percent of the value of the milk and small variations in fat percentage can significantly affect economic returns to dairy producers. In respect of the percentage of milk fat, in this study, maximum and minimum rate of fat recorded were 2.72 %, 4.82% respectively. The current study also showed simple differences in milk protein%, the highest milk protein (3.6%), and the lowest milk protein (2.87%). This study shows that, like the other two components of milk (fat and protein), the percentage of lactose and SNF shows simple differences between the studied samples, where Lactose% was between 4.1-4.84, while SNF% was 7.32-8.83.

The results for the determination of calcium, magnesium, phosphoure in the milk samples obtained without

sample treatment (direct method). The results of the elemental analysis of the milk samples are given in *(Table 2*). advantages of milk mineral concentrate Recently, researchers have been investigating a source of calcium called "milk calcium," a concentrated source of calcium and other minerals derived from milk. Besides calcium, it includes minerals important for bone growth such as phosphorus, magnesium. Phosphorus is needed for effective calcium absorption and bone repair. Milk calcium provides the 1:2 calcium to phosphorus ratio that is optimal for enhancing bone density, according to recent research. Research published in the Journal of the American College of Nutrition showed that as calcium intake increases without an increase in phosphorus, total phosphorus absorption falls and the risk for phosphorus deficiency increases[12]. According to perform a One-Way ANOVA in SPSS Statistics we observed a significant difference ($P > 0.05$) on mineral levels in raw cow's milk farms with some exception of mineral levels in raw cow's milk farms, where there weren't a significant difference. Similar letters means there isn't a significant difference. Differences between farms were convergent for calcium content, ranging from 18 to 27 mM, also the same for magnesium content 14–19 mM and Phosphorous content 53–73 mM. The Na, K, Cl, and Fe concentrations were ranges from 6.4-7.3 mM, 9.1- 10.3 mM, 47-57mM, and 2.9-3.5 mM respectively. Therefore the differences in the content of essential minerals between the farms can be ascribed to different food, age of cows, and origin of this breed.

Conclusion

Concentrations of some major and minor elements in cow's milk at from Najaf province farms are not significantly different, while other parameters in milk obtained from different farms are significantly different, therefore the differences in the content of essential minerals between the farms can be ascribed to different food, age of cows, and origin of this breed. The results of this study showed that the studied cow milk samples generally, contained sufficient quantity of major and minor elements, a fact which has a great impact on its nutritional quality.

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