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A Study on the Fatty Acid Composition of Mare Milk using GLC

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GLC를 이용한 마유의 지방산 조성에 관한 연구

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Abstract

This study was to compare the fatty acid composition of mare milk with cow milk in liquid, powder, cream and oil by gas-liquid chromatography. This study was to compare the fatty acid composition of mare milk with cow milk in liquid, powder, cream and oil by gas-liquid chromatography. These results showed that overall fatty acid concentration of mare milk was much higher than that of cow milk, especially linoleic acid(C18:2) and linolenic acid(C18:3). The concentrations of oleic acid, linoleic acid and linolenic acid of mare milk were higher than those of cow milk in liquid, powder, cream and oil.

Key words : mare milk, fatty acids, linoleic acid, linolenic acid, GLC

INTRODUCTION

Fatty acids are the essential to the well-being, growth and development of children, expecially exclusively breast-fed infants during the fist six months of life(Glew et al., 1999).

Mare milk has interesting nutritional characteristics and is much similar to human milk than does cow milk. Cow milk has the relatively low levels of linoleic acid and DHA in the milk(Glew et al., 1999) and also, the fat of normal milk contained less stearic, lonoleic and linolenic acids than mare milk(Csapo, 1994). The lipid fraction is rich in polyunsaturated fatty acids and high in vitamin C content. Fat globules of mare milk are smaller than those of human milk in size and easier to digest than those of cow milk. Mare milk has a low content of saturated fatty acids with a low number of carbon atoms and a high content of polyunsaturated fatty acids, as human milk and opposite to cow milk. This difference between cow and mare milk depends on their specific physiological characteristics. In addition, mare milk is an interesting product for low-calorie and susceptible adult diets(Solaroli et al., 1993).

The higher unsaturation of fatty acids results in a decreased melting point(Stoyanova, 1988). Analysis of the fatty acid composition of butter-fat of mare milk showed that it contains very small quantities of stearic and palmitoleic acids, and high quantities of linolenic and linoleic acids. This could be explained by the fact that unsaturated fatty acids are not hydrogenated in the digestive system and horses consume a very large amount of forage, which is rich in unsaturated fatty acids(Csapo et al., 1994). Due to high linoleic acid(CLA) concentration of mare milk, milk fat is an important source of potential anticarcinogens(Jahreis, 1999).

The lipid and ascorbic acid in mare milk were remarkably stable oxidation and physical, chemical or enzymic oxidation of ascorbic acid or chelation of Cu resulted in increased

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oxidative stability, and so this is very useful to preserve food stuff(Sidhu et al., 1976; Marconi et al., 1998).

The purpose of this study was to compare fatty acid composition of mare milk with cow milk by gas-liquid chromatography.

MATERIALS AND METHODS

Preparation of Samples

The samples for the analysis of fatty acid by gas-liquid chromatography(HP GC 6890, Hewlett Packard Co., USA) on mare milk skim powder, mare milk, mare oil, mare cream, commercial cow skim powder, cow whipping cream and cow milk were collected from Mongolia and prepared by the method of Fig. 1.

Each sample was warmed to 37℃ and immediately prior to analysis was vortexed vigorously to achieve uniformity. Cow milk 5 mL and mare powder 1.0 g were added in 100 mL test tubes and vortexed for 20 seconds after added 20 ㎖ MeOH(LC grade) and added 0.5 mL ISTD (Internal Standard) and 0.88% 15 mL KCl. These tubes were shaked in water bath for 30 minutes at 45℃. The pellet was filtrated after separating supernatant and fatty acid methyl esters were extracted into hexane.

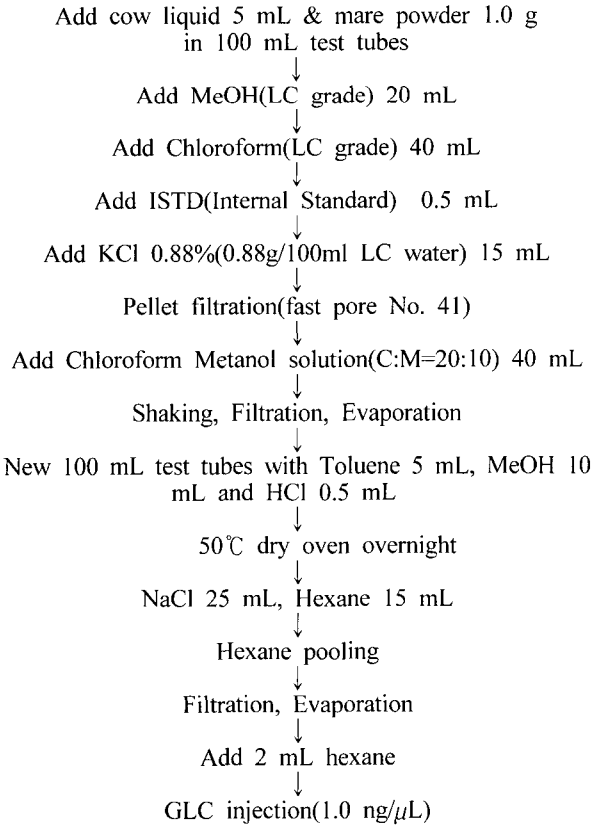

Fig. 1. Diagram of sample preparation for the analysis of fatty acids.

Table 1. Operation condition of GLC for the analysis of fatty acid

Information of gas chromatography	
Oven	Initial temp : 100℃ Initial time : 1.00 min Equilibration time : 1.00 min Ramps : 2.5℃/min, 225℃/15 min Run time: 66 min
Front Inlet	Mode : split(split ratio 10:1)
Column	Nominal diameter : 250 um Nominal film thickness : 0.25 um Initial flow : 0.9 mL/min Nominal init pressure : 16.7 psi Average velocity : 25 cm/sec
Front Detector	Temperature 250℃ Carrier gas : helium

Fatty Acid Analysis

The sample was analyzed using a Hewlett-Packard gas-liquid chromatography equipped with a flame ionization detector. The oven temperature was programmed to increase from 100 to 250℃ at a rate of 4℃ per min and to hold at 250℃ for 18 min Column(Supelco 2-4079, Hwelett Packard Co., USA) flow initial rate is 0.9 mL/min. Fatty acid methyl esters were identified by comparison of their retention times with those of internal standards(C-17, Sigma). The preparation of fatty acid is followed by Folch's extraction method.

RESULTS AND DISCUSSION

The fatty acid composition of mare and cow milk was summarized in Table 2. Mare cream, milk, powder and oil had much higher in linoleic and linolenic acid than cow milk, relatively. Mare cream was 7 times higher than cow cream in linoleic acid and was almost 50 times in linolenic acid. These result trends were similar to other samples in linoleic and linolenic acid.

Fig. 6 showed mare cream was relatively high in linoleic and linolenic acid. Also, Fig. 7 on fatty acid composition showed that the polyunsaturated fatty acid content(C18:2 and

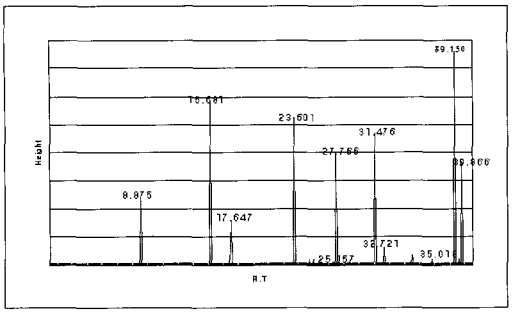

Fig. 2. GC chromatogram of mare cream.

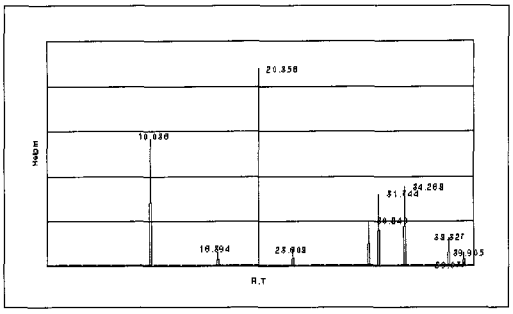

Fig. 4. GC chromatogram of mare skim powder.

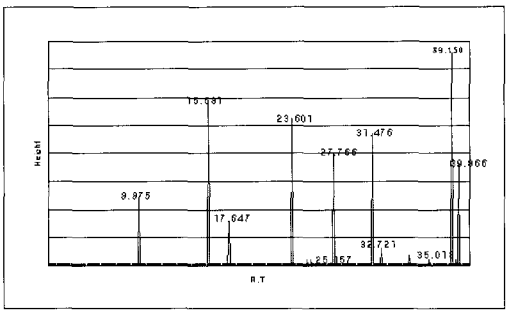

Fig. 3. GC chromatogram of mare milk.

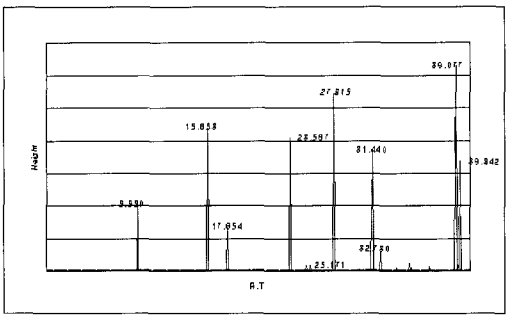

Fig. 5. GC chromatogram of mare oil.

Table 2. Comparison of free fatty acid concentration (mg/ml) in mare milk with cow milk

Carbon skeleton	Cream (mare)	Cream (cow)	Liquid (mare)	Liquid (cow)	Powder (mare)	Powder (cow)	Oil (mare)
C8	3.221	0.710	0.299	0	0	0	16.943
C10	12.739	1.772	1.156	0.107	0.321	0	59.851
C12	13.835	2.491	1.474	0.208	0.571	0	68.476
C14	14.004	6.347	1.495	0.466	0.561	0.281	68.964
C16	41.567	15.734	3.913	1.111	1.572	0.999	211.108
C18:0	2.234	6.169	0.143	0.388	0	0.454	13.851
C18:1	32.229	11.936	2.476	0.675	1.022	1.099	199.841
C18:2	14.034	2.211	1.121	0.095	0.481	0.285	72.336
C18:3	49.686	0.226	4.571	0	1.182	0	256.618
C20	0	0	0	0	0	0	3.452

C18:3) of mare milk and powder samples was much higher than that of cow milk. This high variability in fatty acid composition of mare milk is the most likely due to the greater influence of feed stuffs in horses than in ruminants(Marconi, 1998).

As regards mono-unsaturated, mare and cow samples had a similar content(C18:1), whereas mare milk had higher than cow samples and other mare samples. Also, mare milk had relatively higher in palmitic acid(C16) than cow milk.

The high content of unsaturated fatty acids allows good digestibility. Also, unsaturated fatty acids have a good healing properties on diseases such as arteriosclerosis, cardiovascular disease and so on.

The comparison of the fatty acid composition of mare milk(Fig. 8) showed 20~25% higher concentration at the 0~45 day than cow milk in linolenic acid. A linoleic and linolenic acids are not only a source of energy but also have a good effect on oxygen supply. For these reasons, mare milk is highly sensitive to preservation and transformation processes.

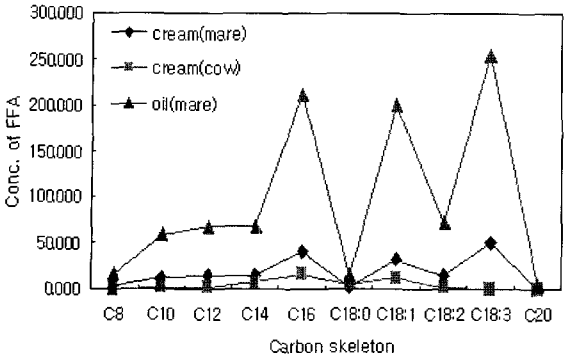

Fig. 6. Comparison of free fatty acid concentration in mare cream, cow cream and mare oil.

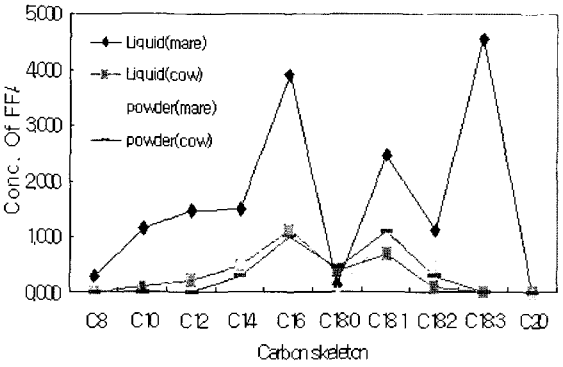

Fig. 7. Comparison of free fatty acid concentration in mare milk, cow milk, mare powder and cow powder.

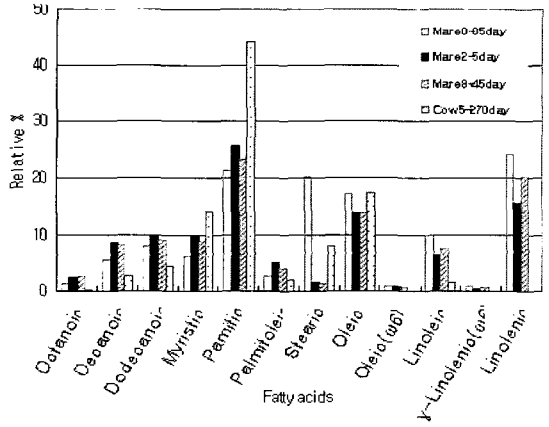

Fig. 8. Fatty acid composition of mare and cow milk.

Linoleic acid and linolenic acid are essential fatty acids can be taken from food and very important component for the low cholesterol in blood.

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요 약

마유의 지방은 적은 양의 stearic acid과 palmitoleic acid를 가지고 있으며 반면에 많은 양의 linolenic acid과 linolic acid를 가지고 있다. 마유와 우유의 지방산을 비교하였을 때, oleic acid (C18:1)의 양은 차이가 없었으며, 불포화 지방산 성분인 linoleic acid와 linolenic acid은 마유가 우유에 비해 상대적으로 높았으며 마유 크림에서의 linoleic acid (C18:2)는 우유보다 약 7배, linolenic acid (C18:3)은 약 50배 높은 것을 관찰하였다. 마유와 우유의 시료를 기간별로 실험한 결과 마유의 시료를 채취한 후 45일 동안 linoleic acid와 linolenic acid를 우유와 비교하였을 때 매우 높게 유지되었으며 이 결과 음식물로만 섭취할 수 있는 이 두 성분이 에너지원, 산소공급원으로 매우 유용하게 작용한다는 것을 알 수 있었다.

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