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A PROFILE OF DIETARY AND MILK FATTY ACIDS FOR LACTATING BUFFALOES

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ABSTRACT

This study aimed to compare between dietary and milk fatty acids and to search for conjugated linoleic acid (CLA) in buffaloe milk fat. So, twelve heteroparity lactating buffaloes at different stages of lactation were used to collect milk samples. All animals received the same diet consisting of 59% Egyptian clover (berseem), 20.4% rice straw and 20.6% yellow corn (on a dry matter basis).

The results indicated that the dietary contained mainly margaric ($c_{17:0}$) and myristoleic ($c_{14:1}$) acids. However, milk fat contained mainly stearic ($c_{18:0}$) and palmitoleic ($c_{16:1}$) acids. The ratios of saturated to unsaturated fatty acids were 49.03: 50.28 and 55.43:43.97% for dietary and milk fat, respectively. Concerning the healthful CLA, the data showed the absence of CLA in buffaloe milk fat.

This study revealed that milk fatty acids are affected by those in the diet.

Key words: *conjugated linoleic acid, dietary fatty acids, lactating buffaloes, milk fatty acids.*

1. INTRODUCTION

It is of interest to report that milk fatty acids are either derived from dietary sources and transported to the mammary glands or synthesized *de novo* by mammary epithelial cells and then esterified in the epithelial cells before secreted into milk (Palmquist and Beaulieu 1993).

The most important fatty acids are linoleic ($c_{18:2}$), linolenic ($c_{18:3}$) and arachidonic ($c_{20:4}$) being essential fatty acids (EFAs) which form a part of various membranes and certain lipoprotein enzymes. They play a role in lipid transport. Also, they are the precursors of prostaglandin synthesis (Mc Donald *et al.* 1988).

Ruminal biohydrogenation of unsaturated fatty acids ($c_{18:2}$ and $c_{18:3}$) involves an isomerization reaction. In this reaction, the linoleic acid cis-9, cis-12 is converted into linoleic acid cis-9, trans – 11 isomer which is called conjugated linoleic acid. This isomer is reduced to vaccenic acid ($c_{18:1}$ trans-11) and ultimately to stearic acid ($c_{18:0}$) (Jenkins 1993). Some trans – isomers produced in the rumen escape from further biohydrogenation and ultimately are incorporated into storage lipids and milk fat (Wu *et al.* 1991). Some workers suggested that milk conjugated linoleic acid could be synthesized of $c_{18:1}$ trans – 11 in the mammary gland (Corl *et al.* 1998 and Griinari *et al.* 2000).

Recent excitement about conjugated linoleic acid (CLA) in milk and milk products arises from the fact that CLA inhibits the growth of many types of tumors including brest tumors, prostate carcinoma, melanoma, colon carcinoma and ovarian carcinoma (Fitch– Haumann, 1996, Molkentin, 2000 and Stanley and Hunter, 2000).

This research represents an overview on both dietary and milk fatty acids' profile for lactating buffaloes fed mainly on Egyptian clover. Also, it respresents an attempet to search for CLA in buffaloe milk fat.

2. MATERIALS AND METHODS

This work was carried out at the Experimental Farm of the Department of Animal Production, Faculty of Agriculture, Ain Shams University.

Twelve heteroparity lactating buffaloes at different stages of lactation (live body weight (LBW) from 505 to 650 Kg) were used to collect milk samples for fatty acid determination during 42 days.

All animals were fed twice daily. The maintenance requirements were 2.75 Kg starch equivalent (SE) and 275 g. digestible protein (DP) for the first 450 Kg LBW and each 50 Kg over this weight requires 0.2 Kg SE and 30 g DP. The productive requirements were o.5 Kg SE and 100g DP for each Kg of milk produced (7% fat) (El-Ashry 1980). All animals received the same diet consisting of berseem (Egyptian clover), rice straw and yellow corn at 59: 20.4: 20.6%, respectively (on DM basis). Drinking water was available ad.lib.. The chemical composition of diet ingredients is shown in Table (1). The analytical methods were performed according to A.O.A.C. (1995). Samples of feeds were taken for fatty acids determination.

All animals were milked individually twice daily (6 a.m. and 3 p.m.). For each animal, milk yield was recorded precollecting in one vat. In the morning, a milk sample (250 g.) was taken of the vat weekly for six weeks. Milk samples were frozen until analysis for milk fat and fatty acids. Milk fat content was analysized by the method of Ling (1963). The averages of daily feed intake, daily milk yield and milk fat content are shown in Table (2).

Determination of individual fatty acids in both feed and milk was done according to Vogel (1975), Farag *et al.* (1986) and A.O.A.C (1995) at the Central Lab., Faculty of Agriculture, Cairo University. The main steps of this determination were: fat extraction, methylation of fatty acids and fractionation of fatty acids' methyl esters.

The fatty acids separation was done using Gas Liquid Chromatography / Pye Unicam Pro – GC. This instrument is characterized by column: sp- 2310, 55% Cyanopropyl Phenyl Silicone Dimensions 1.5 m x4 mm.; Temperature programming: initial temp. 70c° (rate 8c° / min), final temp. 190c° (final time 35 min), injector 250c°, detector 300c°, Gases flow rate: N_2 30ml/ min, H_2 33 ml/ min, air 330 ml/min.; and Chart speed: 0.4 cm/min.

To search for conjugated linoleic acid ($c_{18:2}$ cis –9, trans – 11) in buffaloe milk fat, a part of the previous fatty acids' methyl esters was towarded to Gas Chromatography varian 3400 equipped with finnigan mot SSQ 7000 mass spectrometer (Thermo. Inst. Inc. USA). Mass mode: EI,70 eV. Injector temp 200c°, transition line temp: 250c°, column programming: 50c° (3min) 7c°/min, 250c° (10min). This instrument is available at the Central Services Lab, National Research Center. Dokki.

Table (1): The chemical composition of diet ingredients (on DM basis %) .

Ingredients	DM%	CP	EE	CF	NFE	Ash
Berseem	17.75	14.45	2.40	22.10	47.15	13.90
Rice straw	91.80	02.50	01.00	37.50	44.50	14.50
Yellow corn	93.20	08.20	04.50	12.10	69.00	6.20

DM= dry matter, CP= crude protein, EE= Ether extract, CF= Crude fiber,
NFE= nitrogen free extract.

Table (2): Averages of daily feed intake, daily milk yield and milk fat content.

Items	Kg/ day/ head	%
Daily feed intake:		
Berseem	30.00	
Rice straw	02.00	
Yellow corn	02.00	
Daily DM intake:		
Berseem	05.32	59 of total DM intake
Rice straw	01.84	20.4 of total DM intake
Yellow corn	01.86	20.6 of total DM intake
Daily milk yield	05.50	
Milk fat content		6.50

3. RESULTS AND DISCUSSION

Data in Table (3) indicate that margaric and myristoleic acids were the major components of all fatty acids in diet ingredients. Berseem had the highest percentage of margaric (46.2%) while rice straw had the highest content of myristoleic acid (47.21%). Meanwhile, yellow corn was the best source of arachidic acid and had the highest level of both oleic and linoleic acid. Although the total percentage of the two acids for corn (24.32%) was approximately eight times of that in berseem (3.06%), non of them were found in rice straw.

It was noticed that buffaloe milk fat contained mainly stearic and palmitoleic, representing 35.4 and 33.65% of the total milk fat, respectively. Also, buffaloe milk fat had a considerable percentage of myristic acid (9.73 %). Moreover, the long chain unsaturated fatty acids (oleic and linoleic) represented 5.28 and 1.20% of the total fatty acids, respectively.

3.1. It is of interest to elucidate the comparable profiles of both dietary and milk fat in some points

3.1.1. The closeness of both milk stearic ($c_{18:0}$) and palmitoleic ($c_{16:1}$) percentages from dietary margaric ($c_{17:0}$) and myristoleic ($c_{14:1}$) percentages may reflect the prolongation process in the mammary gland.

3.1.2. It could be noticed that diet and milk had comparable content of oleic acid. This may be attributed to the oleic escaping from further ruminal biohydrogenation.

3.1.3. However, increasing the total saturated fatty acids in milk (55.43%) over that in dietary fat (49.03%) may reflect the occurrence of biohydrogenation process in the rumen.

Obviously, the previous trend of saturated to unsaturated fatty acids (55.43 to 43.97%) in buffaloe milk fat is in line with that reported by Kholif *et al.* (2000). The workers fed the control group of lactating buffaloes on a diet consisting of 30% berseem, 20% rice straw, and 50% concentrate feed mixture. They found that the ratio of saturated to unsaturated fatty acids in the milk was 71.52 to 28.48% respectively. The remarkable difference between the two studies may be due to the variation in both roughage to concentrate ratio and concentrate type.

Table (3) shows that conjugated linoleic acid (CLA) is not found in milk. This result may be explained on the basis that CLA is an intermediate product of the ruminal biohydrogenation of linoleic acid (Kepler and Tove (1967)). So, any factor that affects this biological process will affect the CLA level in milk fat. Thus, the CLA absence in buffaloe milk fat may be attributed to the type and amount of dietary fatty acids or forage to grain ratio, the dietary nitrogen or even to the animal species (Noble *et al.* (1974), Gerson *et al.*(1983), Gerson *et al.* (1985) and Lawless *et al.* (1999)).

However, Abu-Ghazaleh *et al.* (2002) fed Holstein cows on (1) control; (2) 0.5% fish oil. (3) 2.5% soybean oil and (4) 0.5% fish oil and 2% soybean oil, and they found that CLA ($c_{18:2}$ cis –9, trans –11) was 0.33, 0.47,0.79 and 1.39g / 100g milk fatty acids for 1,2,3, and 4, respectively.

Generally, it could be concluded that the profile of milk fatty acids is affected by that in diet. The CLA was not found in buffaloe milk fat in this study.

Table (3): A profile of fatty acids in diet ingredients, total diet* and milk (g/100gfat).

Fatty acids	Diet Ingredients			* Total Diet	Milk
	Berseem	Rice straw	Yellow Corn		
Saturated fatty acids< ^{C}14:0	2.60	4.14	4.00	3.40	1.50
Saturated fatty acids ≥ ^{C}14:0:					
Myristic (tetradecanoic) (^{C}14:0)	3.3	4.01	2.7	3.32	9.73
Palmitic (hexadecanoic) (^{C}16:0)	1.25	2.72	1.0	1.49	3.87
Margaric (heptadecanoic) (^{C}17:0)	46.2	29.5	27.4	38.81	.86
Stearic (Octadecanoic) (^{C}18:0)	n.f[1]	n.f	n.f	n.f	39.4
Arachidic (Eicosanoic) (^{C}20:0)	1.2	n.f	6.20	2.01	0.07
Total saturated fatty acids	54.55	40.37	41.3	49.03	55.43
Unsaturated fatty acids:					
Myristoleic (tetradecenoic) (^{C}14:1)	35.0	47.21	25.3	35.40	3.84
Palmitoleic (hexadecenoic) (^{C}16:1)	6.79	11.86	9.0	8.27	33.65
Oleic (octadecenoic) (^{C}18:1)	2.50	n.f	12.44	4.09	5.28
Linoleic (octadecadienoic) (^{C}18:2cis-9,cis12)	.56	n.f	11.88	2.82	1.20
Conjugated linoleic (^{C}18:2 cis-9, trans-11)	n.d[2]	n.d	n.d	n.d	n.f
Total unsaturated fatty acids	44.85	59.07	58.62	50.58	43.97
Unknown	.60	.56	.08	.39	.60

[1]n.f=not found [2]n.d.= not determined * calculated

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صورة للأحماض الدهنية بعليقة ولبن الجاموس الحلاب

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ملخــــص

من المعروف أن الفروق بين الدهون ترجـع لاختلافـها فـي أحماضـها الدهنية. والأحماض الدهنية باللبن إما أن يكون مصدرها العليقة أو تصنع في الغدة اللبنية ولذا تهدف هذه الدراسة إلي مقارنة كل من دهن اللبن والعليقة مع الكشـف عن الحمض الدهني المعروف باسم conjugated linoleic acid (CLA) بدهـن اللبن الجاموسي.

وقد استخدمت في الدراسة ١٢ جاموسة حلابة في مراحـل مختلفـة مـن الحليب لجمع عينات اللبن للتحليل. وغذيت كل الحيوانات علي عليقة واحدة وهـي مكونة من ٥٩% برسيم + ٢٠,٤% قش أرز+ ٢٠,٦% ذرة صفراء (علي أساس المادة الجافة).

أوضحت النتائج أن دهن العليقة يحتوي أساسا علـي الحمضيـن الدهنييـن margaric و myristoleic بينما يحتوي دهن اللبن أساسا علي الحمضيين الدهنييـن stearic و palmitoleic وكانت نسبة الأحماض الدهنية المشبعة إلي غير المشـبعة ٤٩,٠٣:٥٠,٢٨ و ٤٣,٩٧:٥٥,٤٣% في دهن العليقة واللبن علي التوالي، أما فيمـا يتعلق بالحمض الصحي والمفيد CLA فلقد أوضحت الدراسة عدم وجوده بدهن اللبـن الجاموسي. واستنتجت الدراسة أن الأحماض الدهنية باللبن تتأثر بتلـك التـي فـي العليقة.