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Fatty Acids and Amino Acids Composition of Milk and Resultant Domiati Cheese Produced from Lactating Cows Fed Different Energy and Protein Sources Rations

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Abstract: This study was conducted to evaluate the partial yellow corn with replacement of cassava root meal as energy sources enriched with corn gluten or brewers residues in rations of Crossbred Friesian cows. swing over method was used to study the effect of 5 rations on amino and fatty acids in milk cows as the follows: Ration1 (Control): contained 30% yellow corn, Ration2: contained mixed of cassava root meal (CRM) with corn gluten instead of 25% from yellow corn, Ration3: contained mixed of cassava root meal (CRM) with corn gluten instead of 50% from yellow corn, Ration4: contained mixed of cassava root meal (CRM) with Brewers residues instead of 25% from yellow corn and Ration5: contained mixed of cassava root meal (CRM) with Brewers residues instead of 50% from yellow corn. Results indicated that short chain saturated fatty (C6 - C12) were higher in the milk resulted from the experimental rations than the control ration also milk resulted from R2 and R3 showed lower total saturated fatty acids than control ration. Also mono-unsaturated fatty acids were higher in milk of R2, R3 and R4 rations than control milk ration. Moreover the milk of all experimental rations had higher polyunsaturated fatty acids than control ration. This is of great importance for human health. Fresh Domiati cheese showed similar trend for fatty acids as raw milk. But ripened cheese showed higher saturated and lower unsaturated fatty acids than fresh cheese. Also both milk and Domiati cheese resulted from the experimental rations showed higher levels of some essential amino acids than milk of control ration. So it could be concluded that milk resulted from the experimental rations is of great importance form mutrative and health view for Human.

Key words: Milk · Domiati Cheese · Fatty Acids · Amino Acids · Cows · Yellow corn and Cassava

INTRODUCTION

The fat and proteins content of milk usually shows wide variations than do the other milk ingredients. Several factors may concur to affect it, including the animal species, breed, lactation, cows age, the rearing conditions, the environment and the feeding composition [1]. Commonly, dietary starch recommendations range between 23 to 30% and total NDF 28-32% of dry matter of lactating dairy cow rations [2]. On the other side, the amino acid pool to meet requirements comes from undegraded dietary protein and microbial protein. Generally, the nature of carbohydrate and crude protein sources in the rations are very important for lactating dairy cattle, which effect on rumen micro-organisms and rumen products as volatile fatty acids and microbial protein and consequently effect on milk composition and resultant products which relatively affect human health and growing children. Over the last few years, the FA content and quality of human foods has become a major nutritional topic. Evidence of this can be found in the latest French nutritional guiines that indicate the recommended intake of individual FA in a diversified diet [3]. Milk is a nutritious, widely consumed food that has potential to become more healthful if saturated fat can be decreased and unsaturated fat can be increased. Cassava root meal as a cheap energy source are a rich in carbohydrate and poor in protein [4-6]. Some studies have been carried out on the effects of cassava root as energy source with protein sources replacing until 50% of the

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maize grain in lactating dairy cattle rations [7-10]. Interest in the chemical composition of animal fats has increased steadily since the first scientific reports were published on the negative effects of these fats on human health. The consumption of milk and often of other milk products has decreased owing to widespread reports on the hypercholesterolemia effects of certain fatty acids (FAs) in humans. Such a situation has stimulated interest in research into altering milk fat (MF) composition. Fatty acids, the most important component of MF, which constitute about 90% of its weight. Over 95% of the FAs are bound in triacylglycerols, the remainder in mono- and diacylglycerols, phospholipids and cholesterol esters. Free FAs are present in small proportions. Fatty acids differ in chain length and degree of unsaturation, position and orientation of double bonds. Among the hundreds of FAs that have been identified in MF, only 15 occur at concentrations of 10 g per kg or higher. Saturated and unsaturated FAs constitute about 65% and 35% of the FAs, respectively [11,12].

This work was conducted to study the effect of partial replacement of yellow corn by cassava root meal as energy source enriched with corn gluten or brewers residues as protein sources in lactating cow rations on amino acids and fatty acids of resultant milk and Domiati cheese.

MATERIALS AND METHODS

Five complete rations were prepared as shown in Table (1):

Two groups of lactating crossbred Friesian cows (3 in each) in the 3rd lactating season were used after 7 weeks of parturition to test the experimental rations at Al-Arish, North Sinai Governorate by using swing over method as described by Galal *et al,* [10] as shown in Fig. 1. The 1st group was fed ration1 (control) followed by ration 2, ration 3, then come back to the control ration. The 2nd group was fed ration 1 (control) followed by ration 4, ration 5, then come back to the control ration.

Maintenance and milk production requirements allowances as nutritive values for lactating cows were calculated according to Shehata [13]. Drinking water was available all times. Chemical analysis was carried out according to AOAC [14].

Determination of Fatty Acids: Standard methods of the AOAC [14] were used to determine the fatty acids content of milk and cheese Domiati (Method 989.05). The esters were analyzed using a gas chromatograph (GC) system

Table 1: Formulation of tested complete rations.

	Rations				
Items	R1 (Control)	R2	R3	R4	R5
Ingredients, Kg					
Yellow corn	30	22.5	15	22.5	15
MCRM with CG*	-	7.5	15	-	-
MCRM with BR**	-	-	-	7.5	15
Cotton seed meal	20.625	20.625	20.625	20.625	20.625
Wheat bran	18.75	18.75	18.75	18.75	18.75
Rice bran	3	3	3	3	3
Wheat straw	25	25	25	25	25
Molasses	1.5	1.5	1.5	1.5	1.5
Ground limestone	0.75	0.75	0.75	0.75	0.75
Common salt	0.375	0.375	0.375	0.375	0.375

R1= Control (30% yellow corn, mixed of cassava root meal with corn gluten replaced at a rate of 25% or 50% from yellow corn in ration 2 (R2) and ration 3 (R3), respectively, while mixed with Brewers residues at the same ratio were shown in ration 4 (R4) and ration 5 (R5), respectively

**Mixture of cassava root meal with corn gluten.*

***Mixture of cassava root meal with Brewers residues.*

Model HP 6890 series (USA). The capillary column: Model number, Agilent 1909 1 N- 116; Hp-INNOWax Polyethylene Glycol; Nominal length, 60.0 m; Nominal diameter, 320.0 µm; Nominal film thickness, 0.25 µm; Initial flow, 0.2 ml/min under the following conditions:

- Column head pressure200 KPa
- Split flow rate34 ml/min
- Oven temperature
- Initial temperature 70°C
- Initial time 2 min.
- Program rate 5 °C/ min.
- Final temperature240 °C
- Final time5 min.
- Injector temperature 260 °C
- Detector temperature280 °C

Determination of Amino Acids Content: The amino acids content of milk and Domiati cheese was determined according to the procedure of Amado *et al*. [15]. The sample analyzed by using an amino acid analyzer LC 3000 Epoendrof, Germany. The instrument condition was: flow rate, 0.2 ml/min, pressure of buffer from 0.0 to 50.0 bars, pressure of reagent from 0.0 to 150.0, reaction temperature, 123 °C.

Where is the statistical analysis, how to compare between 5 ration without statistical analysis.

Statistical Analysis: Statistical analysis for the collected data was subject for linear analysis with use of SAS [16]. Separation among means was carried out using Duncan multiple tests [17].

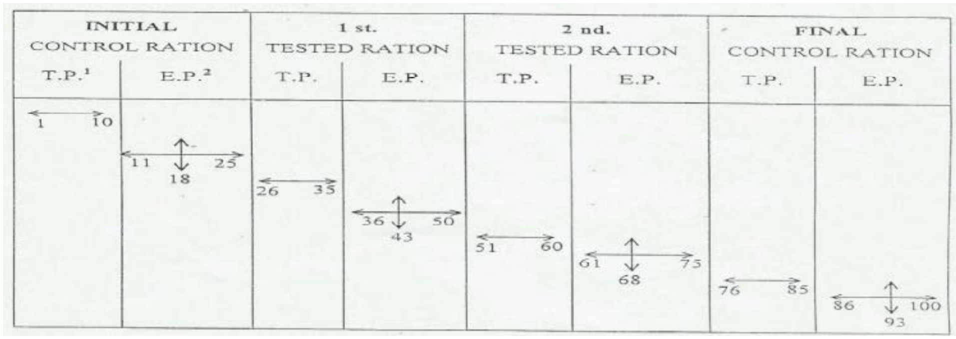

Fig. 1: Succession of days and periods in the" swing-over" method which included two rations, with lactating animals. (Middle days: T.P.: Transition period and E.P.: Experimental period)

RESULTS AND DISCUSSION

Fatty Acids of Milk and Domiati Cheese: Results presented in Table (2) show the fatty acids content of Cows milk fed on the different rations. Results indicated that short chain fatty acids (C6 - C12) were significantly higher in milk of R4 and R5 and insignificantly higher in R2 and R3 than control ration. The saturated fatty acids (C14 - C18) of R2 was significantly lower than other rations while the differents among R1, R4 and R5 were not significant. Concerning the total mono-unsaturated (C14:1 - C18:1) fatty acids results indicated that milk results from R2, R3 and R4 showed significantly higher content than control one, but R5 was similar to control. However milk of different studied rations had significantly higher content of poly-unsaturated fatty acids (C18:2 - C18:3) than control one. Also R4 and R5 showed the highest levels of these fatty acids and significantly higher than other rations.

These results are in agreement with Miyazawa *et al*. [18] who found that the brewer's grain diet significantly increased the proportions of C18:0 and C18:1 in milk fat of lactating Holstein cows. However, totalC18:2 and C 18:3 of control was significantly lower than other rations. The increase in fatty acids of R4 and R5 may be due to high level of crude fiber in brewer residues (18.34%) when compared with corn gluten (2.3%) or yellow corn (3.8%) as showed by Aiad *et al*. [9] and consequently increase acetic acid. From another point of view, Aiad *et al*.[9] found that total volatile fatty acids (VFA) in the rumen was higher when the rations contained mixed of cassava root meal with brewer residues than yellow corn or cassava root meal with corn gluten, while[19] found that total volatile fatty acids (VFA) concentration did not differ among corn gluten meal and other proteins for lactating cows.

From these results it could be noticed that these rations increased the poly- unsaturated fatty acids of resultant milk. This is of great importance for human health. These acids may protect the humans from heart diseases, Kratz *et al*. [20].

Concerning the fatty acids of resultant Domiati cheese it could be noticed from data presented in Table (3) that fresh cheese showed similar trend for fatty acids found for raw milk (Table, 2). However, ripened cheese showed higher increase in total saturated and decrease in total unsaturated fatty acids than fresh cheese. Also Domiati cheese resulted from milk of R4 and R5 showed significantly higher mono-and poly-unsatuted fatty acids than control either fresh or after ripening. So it could be noticed that consumption of fresh Domiati cheese are more save than ripened cheese for those sufferance from heart - decease. Whereas ripened cheese showed higher levels of saturated fatty acids than that of fresh cheese.

Amino Acids of Milk and Domiati Cheese : The essential and nonessential amino acids are presented in Table (4). The Valine as essential amino acid and Aspartic, Serine, Glutamic, Cysteine and Tyrosine as nonessential amino acids were higher while, Glycine, Isoleucine and Arginine as nonessential amino acids were lower in milk of cow fed control than that fed other rations. On the other side, the milk of R2 had a highest values of Threonine and Histidine as essential amino acids and Proline and Isoleucine as nonessential amino acids. The R3 had a highest values of Leucine, Phenylalnine and Lysine as essential amino acids. The improvement of amino acids of R2 and R3 may be due to the low degradable protein of corn gluten in the rumen [19]. The Methionine as essential amino acids and Aspartic, Serine. Glycine and Alanine as nonessential amino acids of milk of cows fed the rations

Table 2: Milk fatty acids of lactating crossbred Friesian cows fed experimental rations.

Fatty acids	R1(Control)	R2	R3	R4	R5
Saturated Free fatty acids					
C6	3.10	3.02	3.17	3.20	3.38
C8	2.31	2.40	2.39	3.20	3.38
C10	2.66	3.06	3.18	2.80	2.93
C12	3.06	3.14	3.05	3.32	3.26
C6 - C 12	11.13[c]	11.62[c]	11. 79[bc]	12.52[ab]	12.95[a]
C14	12.13	10.96	11.04	11.18	10.46
C16	29.13	28.30	29.14	29.02	29.86
C18	9.90	8.43	9.86	11.07	12.44
C14 - C 18	51.16[ab]	47.69[c]	50.09[b]	51.22[ab]	52.76[a]
Total	62.29	59.31	61.83	63.79	65.71
C 20		0.16	0.30		0.38
Mono - unsaturated Free fatty acid					
C14 : 1	0.21			0.56	0.69
C16 : 1	1.06	0.89	1.30	1.43	1.24
C18 : 1	31.03	33.20	32.89	31.78	30.28
Total	32.30[b]	34.09[a]	34.19[a]	33.77[a]	32.21[b]
Poly - un saturated Free fatty acids					
C18 : 2	1.84	2.04	2.30	2.48	2.76
C18 : 3		0.14	0.42	1.02	0.84
Total	1.84[d]	2.18[c]	2.72[b]	3.50[a]	3.60[a]

[abc] means in the same row with different superscripts are significantly ($p<0.05$) differed.

Table 3: Fatty acids of Domiati cheese from lactating crossbred Friesian cows fed experimental rations

	Control R1		R2		R3		R4		R5	
Free fatty Acids	Fresh	Ripening	Fresh	Ripening	Fresh	Ripening	Fresh	Ripening	Fresh	Ripening
Saturated Free fatty acids										
C6	1.23	2.76	1.48	2.64	1.53	2.73	1.82	2.79	2.00	2.84
C8	0.84	3.31	0.93	3.81	0.98	3.94	1.38	3.20	1.42	3.41
C10	1.31	2.24	1.22	2.43	1.38	2.51	1.27	2.31	1.37	2.47
C12	1.75	4.61	1.68	4.41	1.62	4.92	1.82	4.81	1.90	4.91
C14	6.95	4.68	7.10	4.87	7.30	5.31	6.41	5.81	6.58	6.10
C16	25.49	20.14	26.71	23.21	26.31	24.80	24.10	2270	24.67	24.00
C18	5.86	8.00	6.13	9.31	6.73	9.71	6.31	9.38	6.82	9.41
C 20	1.41	3.72	1.10	3.31	1.00	3.61	0.89	3.10	1.73	3.61
	44.84[b]	49.46[E]	46.36[a]	53.99[D]	46.85[a]	57.53[A]	44.00[b]	55.10[C]	46.49[a]	56.75[B]
Mono - un saturated Free fatty acids										
C14 : 1	0.70	0.37	0.68	0.42	0.70	0.63	0.93	0.81	1.03	0.89
C16 : 1	2.62	0.80	2.41	0.74	2.36	0.38	2.84	0.62	2.91	0.68
C18 : 1	39.37	21.29	38.41	24.67	40.10	23.74	41.31	28.41	42.10	29.10
	43.02[c]	22.50[E]	41.55[d]	25.85[C]	43.07[c]	24.77[D]	45.08[b]	29.84[B]	46.04[a]	30.67[A]
Poly - un saturated Free fatty acids										
C18 :2	4.59	3.91	4.21	3.84	4.10	4.15	4.82	4.63	4.97	4.61
C18 : 3	3.50	6.43	3.40	6.00	3.38	5.41	4.00	5.84	4.13	6.42
	8.09[b]	10.34[B]	7.61[c]	9.84[C]	7.48[c]	9.56[C]	8.82[a]	10.47[B]	9.10[a]	11.03[A]

[abc] means in the same row with different superscripts are significantly ($p<0.05$) differed.

[ABCDE] means in the same row with different superscripts are significantly ($p<0.05$) differed.

Table 4: Amino acids content of resultant milk of lactating crossbred Friesian cows fed experimental rations.

Amino acids	R1(Control)	R2	R3	R4	R5
Aspartic	7.40	6.81	6.41	7.14	6.85
Threonine	2.31	2.61	2.39	2.00	2.03
Serine	6.62	5.84	6.20	6.43	6.25
Glutamic	23.00	22.91	22.86	22.54	21.85
Proline	11.28	12.05	11.98	11.42	10.89
Glycine	1.92	2.03	2.51	2.03	2.54
Alanine	3.41	3.28	3.21	3.51	3.48
Cysteine	0.38	0.28	0.31	0.28	0.30
Valine	7.25	6.89	6.98	6.52	7.02
Methionine	3.2	3.15	3.08	3.52	3.21
Isoleucine	5.62	6.60	6.54	5.48	5.98
Leucine	9.18	10.02	10.32	10.04	9.84
Tyrosine	5.81	5.21	5.00	4.98	5.02
Phenylalnine	5.4	5.28	5.62	5.24	5.36
Lysine	8.10	8.23	8.41	8.02	8.05
Histidine	3.20	3.51	3.28	3.00	3.12
Arginine	4.15	4.32	4.28	4.06	4.32
Lys:Met ratio	2.5:1	2.6:1	2.7:1	2.3:1	2.5:1

Table 5: Amino acids of fresh and ripening Domiati cheese from lactating crossbred Friesian cows fed experimental rations.

	Control R1		R2		R3		R4		R5	
Amino Acids	Fresh	Ripening	Fresh	Ripening	Fresh	Ripening	Fresh	Ripening	Fresh	Ripening
Aspartic	8.2	11.3	7.8	10.8	8.1	10.9	8.6	11.3	9.1	12.3
Threonine	5.2	6.7	4.8	6.3	5.4	6.9	5.0	6.8	5.3	7.2
Serine	4.8	6.4	4.3	6.4	4.8	6.8	5.1	6.2	5.5	6.5
Glutamic	23.7	21.8	22.1	22.6	22.8	20.8	24.6	21.6	25.3	23.4
Proline	14.6	19.6	13.5	15.4	14.5	18.0	14.5	19.2	15.3	19.6
Glycine	2.0	2.4	1.8	2.3	2.1	2.6	2.0	2.3	2.4	2.8
Alanine	3.1	4.5	3.2	4.1	3.4	4.6	3.0	3.8	3.1	4.2
Cysteine	1.0	0.8	0.7	0.4	0.8	0.6	0.9	0.8	1.0	0.8
Valine	5.3	6.5	5.5	6.7	5.6	6.8	5.4	6.4	5.8	6.8
Methionine	3.1	3.4	2.8	3.1	2.9	3.2	3.2	3.6	3.4	3.8
Isoleucine	5.0	6.1	5.1	5.9	5.3	6.2	4.8	5.4	5.0	5.9
Leucine	10.3	9.4	10.4	9.8	10.6	10.0	9.8	9.7	10.1	9.8
Tyrosine	7.7	8.3	7.9	8.0	8.1	8.4	7.4	7.9	7.5	8.0
Phenylalnine	4.0	5.3	4.1	4.6	4.5	4.8	4.0	4.3	4.2	4.8
Lysine	11.2	11.0	11.4	11.1	11.6	11.3	10.8	11.2	11.3	11.6
Histidine	3.1	4.3	4.3	5.2	3.8	4.6	3.2	3.4	3.5	3.8
Arginine	3.7	4.8	3.6	5.1	3.9	5.2	3.4	4.1	4.0	4.6

contained mixture of cassava and brewers residues (R4 and R5) were higher than that fed the rations contained corn gluten (R2 and R3). The best Lysine : Methionine ratio was recorded with R3 (2.7:1) However, the amino acids of milk protein depends degradable and un-degradable feed protein in the rumen. Rumen microbes degrade a portion of feed protein resulting in precursors for synthesis of microbial proteins. When diets high in rapidly degradable proteins are fed to dairy cattle, rate of degradation may exceed rate of microbial synthesis, resulting in inefficient use of feed nitrogen and excessive ammonia absorption from the rumen. Feeding proteins with resistance to rumen degradability increases the flow of protein to the duodenum, provided that microbial protein synthesis is not reduced. Increased protein flow at the duodenum results in increased production of milk [21]. Armentano *et al.* [22] found that Arginine, Threonine, Phenylalani, Valine Leucine and Methionine and sum or some of aspartate, serine, glutamate, proline, glycine, alanine and tyrosine of in duodenum of lactating cows fed ration containing dried brewers grains were higher and slightly less of lysine than that fed ration containing soybean.

From the forgoing results it could be noticed that feeding cows milk on the experimental rations resulted in increasing the levels on some essential amino acids in both resultant milk and Domiati cheese and this was more noticed in R3 and R5. Also amino acids were higher in ripened cheese than the fresh one.

The essential and nonessential amino acids of raw and ripening Domiati cheese are presented in Table (5). The R2, had a higher values Histidine as essential amino acids Tyrosine as nonessential amino acids, R3 had a higher values Threonine, Leucine, Phenylalnine, Lysine as essential amino acids and Serine, Glycine, Alanine, Isoleucine as nonessential amino acids and R5 had a higher values of Valine, Methionine as essential amino acids and Aspartic, Glutamic, Proline, Glycine, Cysteine and Arginine as nonessential amino acids in raw Domiati cheese as shown in Table (5). Moreover, R3 and R5 which contained high level of cassava with corn gluten or brewers residues had a highest levels of amino acids. On the other hand, the most amino acids were higher in R5 than other rations in ripening Domiati cheese. The optimum Lysine : Methionine ratio was showed in R5 (3:1).

CONCLUSION

From the obtained results it could be concluded that partial replacing of yellow corn with cassava root meal enriched with corn glautein or brewers residues increased the levels of poly-unsaturated fatty acids and some essential amino acids in resultant milk and Domiati cheese. These results are one of great importance for human health.

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