Persistency of conjugated linoleic and vaccenic acids in Argentine Tybo and Sardo cheeses produced from natural high CLA milk

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Abstract

Sardo and Tybo cheeses were elaborated from milk with high conjugated linoleic acid (CLA) and Vaccenic Acid (VA) contents and they were tested to evaluate the persistency of 9- cis 11-trans C 18:2, trans-11 C18:1 and other fatty acids (FA). The natural hi gh CLA milk was obtained from 8 Holstein cows from middle lactation (109 ± 26 days post partum), supplemented with sludge soybean oil (SSO) with 55.5% of C18: 2n 6 and fish oil (FO) as an inhibitor of ru minal biohydrogenation. After 25 days of ada ptation, milk was co llected and transformed i nto Tybo and S ardo argenti ne cheeses repr oducing industrial conditions. Milk and chesses FA compo sition was analyzed by GLC and di fferences in FA content were stated using the T-test for paired observations.

Intake of SSO and FO re duced the atherogenicity index of milk from pre su pplementation basal value of 2.06 to 1. 16, decrea sing the conc entration of atherogenics FA (C12:0; C14:0; an d C16:0). A fter supplementation the milk CLA content increased from a basal value of 1.42 to 3.58 g/100g and VA from 2.56 to 3.58 g/100g FA.

The atherog enicity index of hi gh CLA Sardo and Tybo cheeses were 1. 22 and 1. 29 resp ectively. There was a hi gh transference r ate of CLA 9 cis 11 tran s: 95% for T ybo chees e and 97% for S ardo chees e. Assuming that the chees e fat contai ns 95% FA , an i ntake of 9 0 g/day of Sardo and 14 3 g/day of Tybo high CLA cheeses may al low achieving cardiovascular protection (800 mg) to the consum er of CLA . The beneficial effect of functi onal foods may be effective onl y within a com prehensive nutrition and h ealthy lifestyle.

Keywords: Sardo, Tybo, argentine cheese, conjugated linoleic acid; atherogenicity index.

1. Introduction

The h ealth qu ality of fat p resent in t he d airy p roducts d epends o n it s composition o f fa tty a cids (FA). Conjugated l inoleic a cid (CLA) is a g roup o f p ositional and geometri c i somers of conjugated di enoic derivatives of li noleic acid. The majo r di etary sou rce of CLA f or humans i s rumi nant f at contai ned in meats, (beef and lamb), but meanly in dairy products, such as milk, butter and cheese. The major isomer of CLA in milk is cis-9, trans-11 (C18:2), also called rumenic acid. It is produced in part in the rumen from linoleic FA together with vaccenic acid (trans-11 C18: 1, VA) but mainly by the conversion of VA into CLA by the enzyme del ta 9 desatura se in the ma mmary gl and. Both, VA and CLA showed chol esterol-lowering, an tiatherogenic; anti diabetic and anti carcinogenic effects dem onstrated i n experi mental models.

Our preliminary results showed that the transfers rate of CLA from milk to yogurt, soft-cream cheese and pasteurized milk was ver y effecti ve. We focused now on hard and semi -soft cheeses t o extend oth er possibilities of inclusion of CLA in the daily intake. The objective was to determine if the transformation of natural mil k contai ning high CLA an d VA conten ts i nto Tybo and Sardo cheeses i nduces si gnificant changes in t he concentration o f these b ioactive m olecules in t he fin al p roduct. This ma y contribute to generate dairy functional foods.

Tybo is a semi-soft cheese of great popular consumption, usually used in fast food, while Sardo cheese is a hard variety, usually used during consumption of pasta or stuffed. The daily intake of these high-CLA cheeses can help to increase the incorporation in the human diet of these bioactive molecules. The study represents a joint work between INTI-LACTEOS, the Experimental Station of INTA Balcarce and the company Prodeo SRL, award winner of "La Mirada Larga" INTI competition.

2. Materials and methods

Natural high CLA milk was obtained from 8 Holando-Argentina cows in mid lactation (109 ± 26 days postpartum) supplemented with sludge soybean oil (64% oil, 55.5% of C18: 2n6) and fish oil (FO) as an inhibitor of ruminal biohydrogenation. Prior to start the lipid supplementation period, milk from each cow were sampled to determine the baseline profile of FA.

At day 25th after lipid feeding milk was collected to be processed into cheese. An aliquot of milk was used to determine FA profile and the rest of the milk was pasteurized and transformed into Tybo and Sardo argentine cheeses according to industrial processes.

Fatty acid composition en milk and cheese were analyzed by gas-liquid chromatography using an Agilent GC 6890 Serie Plus fitted with a FID detector and auto-sampler. The column used was W-COT 100 m. Oven conditions were: 70ºC, 1 min, increased 5ºC/min to 100 ºC, hold 2 min, increased 10ºC/min to 160 ºC hold for 52 min and increased 5 ºC/min to 225 ºC hold for 15 min. Injection volume : 1 µl. The gas carrier used was hydrogen.

Atherogenicity index AI was calculated as C12:0 + 4C14:0 + C16 / total unsaturated fatty acids.

The difference of each FA concentration between milk and cheese was analyzed using the Student t test for paired observations.

3. Results

Milk and standardized 4% fat milk yields were 23.4 and 18.6 kg per cow per day respectively.

Fat, protein and lactose content in Tybo cheese milk were 2.42, 3.45 and 4.66 g/100g respectively with a fat/protein ratio of 0. 70. Same compositions for Sardo cheese milk were 2. 30, 3.51 and 4.71 g/100g respectively with a fat/protein ratio of 0. 65. Moisture content in Tybo and Sardo cheese were 47.46 (±1.26) and 34. 84 (±2. 58) g/100g. Fat content were 21. 67 (±1. 26) and 26. 73 (±4.03) g/100g respectively. And total protein content were 26.84 (±1.46) and 31.23 (±2.89) g/100g respectively.

A high transference of CLA from milk to cheese was observed averaging 95% for Tybo and 97% for Sardo cheeses (Table 1)

Table 1. Main fatty acid composition in milk (M –CLA) and its transfer to Tybo (Tybo C –CLA) and Sardo cheeses (Sardo C-CLA).

Fatty acids (g/100 g total FA)	M-CLA	Sardo C-CLA	SC-CLA/M-CLA x 100	M-CLA	Tybo C-CLA	C-CLA/M-CLA x 100
C12:0	2.38	2.33	98	2.2	2.54	115
C14:0	9.04	9.27	103	8.88	9.73	110
C16:0	24.27	24.95	103	25.87	25.9	100
C18:1t10	4.22	5.95	141	5	3.89	78
C18:1t11 (AV)	5.43	5.89	109	3.55	4.48	126
CLA c9t11	3.58	3.51	98	2.86	2.72	95
CLA c12t10	0.02	0.03	144	0.04	0.05	115
$C_{20:5\ n3}$ (EPA)	0.05	0.04	77	--	--	--
$C_{22:6\ n3}$ (DHA)	0.03	0.03	100	0.04	0.04	100
AI	1.16	1.22		1.16	1.29	

The Atherogenicity Index (AI) of milk in pre-supplementation was 2. 06 (± 0. 24) and concentration of potentially atherogenic fatty acids (g/100 g) were 4.04% (± 0. 65) for C12: 0, 12. 52 % (± 1. 37) for C16:0 and 29.16 % (±2.38) for C14:0.

The AI of high CLA milk and high CLA Tybo and Sardo cheeses were 1.16, 1.29 and 1.22 respectively and are shown in Figure 1.

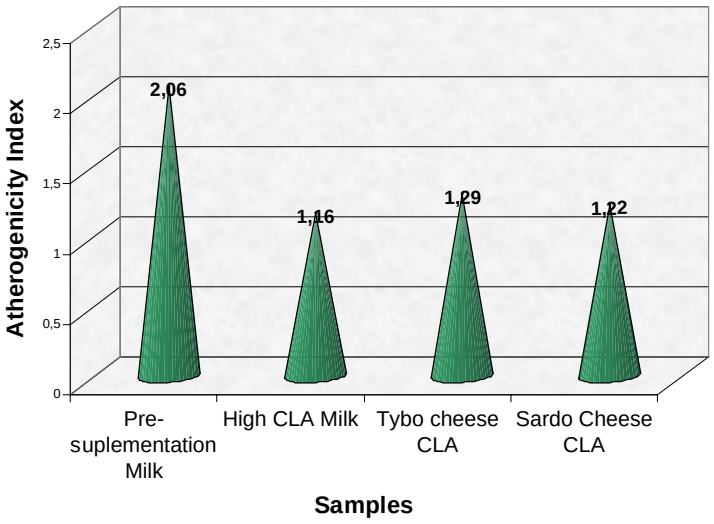

Figure 1. Atherogenicity Index from hich CLA cheeses.

4. Conclusions

Intake of SSO and FO reduced the atherogenicity index of milk from pre supplementation basal value of 2.06 to 1.16, decreasing the concentration of atherogenics FA (C12:0; C14:0; and C16:0). After supplementation the milk CLA content increased from a basal value of 1.42 to 3.58 g/100g and VA from 2.56 to 3.58 g/100g FA.

The cheese-making process did not alter the fatty acid profile observed in the original milk.

A high transference rate of 9cis-11 trans CLA and VA was observed in both cheeses. Lipid supplementation reduced the atherogenicity index in milk and this property was maintained in cheeses.

Assuming that the cheese fat contains 95% FA, intake of 90 g/day of Sardo or 140 g/day of Tybo cheeses rich in CLA, may allow obtain the suggested anticancer dose (800 mg) of CLA.

The beneficial effect of functional foods may be effective only within a comprehensive nutrition and healthy lifestyle.

Successful transfer of this research to cheese industry was done. Support from INTI Dairy Industry Research Centre was doing to develop more healthy cheeses. Nowadays, these healthy cheeses are being commercialising in the Argentine market.

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