Comparison of fatty acid profile in lamb meat and baby food based on lamb meat

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ABSTRACT - The aim of this study was to compare the fatty acid (FA) profile of fresh lamb meat with those of baby foods based on lamb meat. For this purpose, samples of commercial homogenized (HO) and lyophilized (LIO) baby food based on lamb meat and fresh lamb meat (FM) were analyzed for their FA composition. All fatty acids, except for oleic acid and conjugated linoleic acid (CLA), differed among the three baby products tested. The sum of omega-6 FA and the ratio omega 6/omega 3 FA were lower in FM and LIO meat compared to HO samples. The content of total PUFA n-3 was the highest in FM, because of its highest content of C18:3 n3, EPA, DPA and DHA compared to LIO and HO baby food. The content of arachidonic acid was more than 6-fold higher in FM compared to LIO and HO. This study evidenced the possibility of enhancing the FA profile of commercial baby food based on lamb meat by using meat with healthier FA profile.

Key words: Lamb, Meat, Fatty acids, Baby food products.

Introduction - The importance of fatty acids (FA) in human nutrition for optimal foetal and neonatal development is well known (Cetin and Koletzko, 2008). At weaning the first meat recommended by Italian pediatricians to be introduced in the baby's new feeding regimen is lamb meat. This is related to the lower allergenicity of this meat to infants with atopic dermatitis compared to other red meats (Martino *et al.*, 1998; Fiocchi *et al.*, 2000). Available information on fat in meat baby foods refers mainly to the total amount of saturated, monounsaturated and polyunsaturated fat, whereas that on FA composition of these products is not commonly given. Moreover, the origin of the ingredients used in baby foods is normally not available for consumers. For example, labels do not indicate neither the kind of lamb meat used nor the amount of lamb meat included in lyophilized baby food. Since the FA composition of lamb meat is strictly related to breed, feeding regimen and slaughtering age and weight (Diaz *et al.*, 2005; Valvo *et al.*, 2005; Lanza *et al.*, 2006; Serra *et al.*, 2009), the origin of lamb meat may influence the final nutritional characteristics of lamb-based baby food. Sarda sheep is the main ovine breed in Italy; thus, meat from suckling lambs of this breed could be a reliable source of meat for the baby food industry. Therefore, the aim of this preliminary study was to compare the FA profile of fresh lamb meat with those of infant foods.

Material and methods - In the year 2008, 12 samples of homogenized lamb meat baby food (80-g jars; HO) and 12 samples of lyophilized (freeze–dried) lamb meat baby food (30-g jars; LIO) produced by two of the main multinational infant-foods companies, and 12 samples of fresh lamb meat (FM) were collected and analyzed. The label of the HO reported a content of 40% of meat, whereas that of the LIO samples did not report the percentage of meat present in the jar. Suckling lambs born from Sarda ewes were slaughtered, and samples of *longissimum dorsi*, *semitendinosus, semimembranosus*

and *femoral biceps* muscles were obtained. After removal of the intermuscular residual adipose tissue from these muscles, the FM samples were freeze-dried and finely ground in a food processor. Fat extraction was performed using chloroform:methanol (2:1). Fatty acid methyl ester (FAME) from the triglyceride fraction was obtained using the standard FIL-IDF methylation procedure (1999). The chromatographic conditions were the same as those described by Nudda et al. (2008). The FA were identified by comparing the retention times of peaks with those of methyl ester standards. The content of each FAME was expressed as a percentage of total FAME. Data were analyzed with one-way ANOVA using type of product as the main effect. Differences were considered significant at $P<0.05$.

Results and conclusions - Even if the average fat content of LIO and HO products determined in the laboratory were in accordance with the medium lipid content reported in their nutritional labels, the values of fat content of LIO and HO products showed a high variability between the two brands

Table 1. Fat content and fatty acid profile of fresh lamb meat (FM) and homogenized (HO) and lyophilized (LIO) baby food based on lamb meat.

	FM	LIO	HO	P
Fat content, % as fed	3.4	15.1	4.0	**
Fatty acid (g/100g of FAME)				
<C14	0.92^{a}	0.48^{b}	0.36^{b}	**
C14:0	5.68^{a}	3.78^{b}	2.37^{b}	**
C14:1	0.17^{a}	0.11^{b}	0.10^{b}	**
C16:0	20.65^{a}	22.62^{a}	17.42^{b}	**
C16:1	1.44^{a}	1.45^{a}	0.92^{b}	**
C18:0	14.43^{b}	20.69^{a}	15.72^{b}	**
C18:1 t11	2.17^{b}	3.70^{a}	2.96^{ab}	*
C18:1 c9	34.27	33.95	32.47	ns
C18:2 c9,c12	6.36^{b}	3.11^{b}	19.51^{a}	**
C18:3 n-3	1.22^{a}	0.91^{b}	0.85^{b}	**
CLA c9,t11	1.28	1.30	0.97	ns
C20:4 n-6	2.09^{a}	0.29^{b}	0.36^{b}	**
EPA	0.57^{a}	0.08^{b}	0.11^{b}	**
DPA	0.87^{a}	0.22^{b}	0.21^{b}	**
DHA	0.56^{a}	0.05^{b}	0.05^{b}	**
CLA total	1.70	1.81	1.49	ns
PUFA n-3	3.22^{a}	1.25^{b}	1.22^{b}	**
PUFA n-6	8.67^{b}	3.42^{b}	19.91^{a}	**
n6/n3	2.77^{b}	2.82^{b}	19.13^{a}	**
SFA	43.83^{b}	50.42^{a}	38.24^{c}	**
MUFA	44.28^{a}	44.90^{a}	40.63^{b}	**
PUFA	11.89^{b}	4.68^{c}	21.13^{a}	**
SFA/UFA	0.80^{b}	1.02^{a}	0.65^{c}	**
AI	0.81^{a}	0.77^{a}	0.46^{b}	**
TI	1.18^{b}	1.66^{a}	1.07^{b}	**

***, P≤0.01; *, P≤0.05; ns, not significant*

^{a,b,c} values within the same row with different superscript differ significantly (P<0.05)

AI, Atherogenic Index; TI, Thrombogenic Index

and among lots of the same brand. In fact, values of fat content ranged from 15.0 and 23.0% in LIO and from 4.0 to 5.4% in HO. The FA profile of the 3 products analyzed are reported in Table 1. The LIO fat showed the highest content of short-chain FA (SFA), due to its highest C18:0 content compared with FM and HO. The content of CLA c9, t11 did not differ among the 3 types of products.

The content of vaccenic acid (VA; C18:1 t11), which represents more than 75% of the total C18:1 trans FA in all products, was higher in LIO and HO compared FM samples. The VA content in the samples ranged from 1.1 to 3.1 in FM, from 1.9 to 5.5 in LIO, and from 0 to 5.3% in HO; with only one sample of HO not having any detectable VA. The FM samples showed the highest content of C18:3 n-3, EPA, DPA and DHA. The content of arachidonic acid (C20:4 n-6), which has an important role in infant nutrition, was more than 6-fold higher in FM compared to LIO and HO samples. Since PUFA are mainly esterified in the phospholipid fraction of meat fat, the lowest levels of PUFA in LIO samples could be related to the high fat content of the lamb meat used for the LIO products. The content of linoleic acid (C18:2 c9, c12) in HO products was almost 3-fold higher than LIO and 5-fold higher than FM samples, probably related to the presence of vegetable oil in HO, usually sunflower oil which is particularly rich in C18:2 c9,c12. This is the reason of the highest content of PUFA n-6 and ratio of omega-6 to omega-3 essential fatty acids (n6/n3) in HO samples compared to LIO and FM samples. The ratio n6/n3 was 19/1 in HO, which is much higher than that of 2-3/1 normally recommended in the diet of humans (Simopoulos *et al.*, 2008). In contrast, the fresh and powered lamb meat had a more appropriate balance between n-3 and n-6 fatty acids, both having a ratio n6/n3 of 2.8. In conclusion, the composition of LIO and HO samples showed a high variability in terms of fat content and fatty acid composition between the two brands sampled and among lots of the same brand. Fatty acid composition was more similar between LIO and FM samples than between HO and FM samples, probably as a consequence of the high level of vegetable oil added to HO products. On the other hand, meat used for LIO products probably originates from lambs heavier than suckling lambs, as reflected by its lowest levels of PUFA. In conclusion, the use of meat from suckling lambs for baby foods may be a reliable way to improve essential and long-chain PUFA content of LIO products. On the other hand, the large use of vegetable oils as ingredients of HO products causes a deep modification of FA composition and, as a consequence, leads to a great difference between the FA profile of HO based on lamb meat and that of fresh lamb meat.

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