Impact of animal production systems on the French Population Reference Intakes for fatty acids

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Abstract – The fatty acids intake of French adult population doesn't comply with the French Population Reference Intakes (PRI) specifically for atherogenic and n-3 polyunsaturated fatty acids. What would be the impact of animal products production system change on the fatty acids intake? A 15-day meal plan representative of average consumption for the French adult male population was developed. It incorporates with animal products derived either from standard production system (STD) or from a specific production (Bleu-Blanc-Cœur, BBC) that acts on the fatty acid profile of animal products. The impact of a change in production method on fatty acid content, in relation to the French PRI has been quantified. The results show that the BBC diet contributes to decrease the intake of atherogenic fatty acids (C12:0-14:0-16:0) (-17.2%), saturated fatty acids (-7.9%) and to improve the intake of ALA (+80%), EPA (+42%) and DHA (+35%). Finally, consuming animal products from the BBC production system reduces from 12 to 70%, depending on the fatty acids considered, the gaps between average intake and the French PRI for fatty acids. The research also shows that animal products complement one another.

Key Words – animal production system, fatty acids, Population Reference Intakes.

I. INTRODUCTION

The French "Apports Nutritionnels Conseillés" (Population Reference Intakes (PRI)) for lipids of the ANSES (French National Agency on Food Safety, Environment, and Workplace Security) highlights the importance of a better balance between n-6 and n-3 polyunsaturated fatty acids (n-6 PUFA and n-3 PUFA) and a reduction of atherogenic saturated fatty acids (C12:0-C14:0-C16:0) [1]. Indeed, consumption study INCA 2 demonstrated that the adult French intake of alpha-linolenic acids (ALA) should be multiplied by 2.5, that of docosahexaenoic acid DHA by 1.8, and that of eicosapentaenoic acid (EPA) by 2.5 to reach the PRI [1,2].

Animal products are the main contributors to the lipid intake of the French population, representing 60 to 67% depending on the study [3]. They could in particular contribute up to 70% of ALA intake in the French diet [3]. Yet, the lipid content of animal products is highly dependent on the production system used, and on feed in particular [4]. With this in mind, in 2001 2000, the "Bleu-Blanc-Cœur Association" established specifications as regards rearing practices, reintroducing for instance plants with a high ALA content (grass, alfalfa, flaxseed, etc.) in animal feed. Such changes in production practices lead to the marketing of animal products with improved lipid profile in relation to conventional practices, and that comply with nutritional recommendations. Nonetheless, although differences in lipid profile are clear between conventional products and those from the Bleu-Blanc-Cœur production system, it appears necessary to measure the impact of such a change in animal production methods on the lipidic intake of humans on an average French diet.

II. MATERIALS AND METHODS

An average 15-day meal plan, that is representative of male French adult (18 years +) population diet, was created. To this end, the most recent data, from the CCAF survey "Comportements et Consommations Alimentaires en France" (Food behaviour and consumption in France, CCAF 2010) conducted by CREDOC (French centre for research and the study and observation of living conditions) [5] was used, in

order to better take into account the food choices of this population and better match actual consumption patterns. From this data, a selection of 92 the foodstuffs most often consumed by the French population was made and an average consumption quantity in g/d was determined for a 15-day meal plan. These quantitative data estimates were then used to calculate the average energy value of this meal plan, its protein, carbohydrate, and lipid contents.

Two case studies were thereafter tested according to the origin of animal products i.e. (i) menu with animal products from conventional system or (ii) menu with animal products from specific Bleu-Blanc-Coeur production system (BBC). In the BBC meal plan, only the profile in fatty acids of animal products (meats, meat products, dairy products, milk, butter, eggs) was amended in relation to the STD diet. Fatty acid content (saturated fatty acids, SFA), monounsaturated fatty acids (MUFA) and PUFA) were calculated for both menus.

The CIQUAL nutritional profile database [6] was used for all foodstuffs (energy, protein, carbohydrates, lipids). Content in fatty acids, also comes from CIQUAL for all foodstuffs, except for meats, meat products, eggs, and dairy products, whose fatty acids profile was updated. Indeed, CIQUAL data available for animal products do not take into account the impact of the production s on the product's fatty acid profile.

Thus, and in order to take into account the difference in fatty acids profile of animal foodstuffs according to their production method, other data sources are used. This data is drawn (i) directly from the database established from the Bleu-Blanc-Cœur association monitoring programme, which compiles the analyses of fatty acids profiles on animal products produced using its production method (data from 2010 to 2013) and/or (ii) from scientific literature referring to these products.

III. RESULTS AND DISCUSSION

The method used in this study to model a 15-day meal plan that is representative of average French consumption, has demonstrated its suitability. Indeed, nutritional profile values for the average French diet in our study are very similar to the consumption averages found in the CCAF survey [5] for the male adult population and globally the lipids and fatty acids intakes are similar to other studies (Table 1) [3,5,7]. In 2015, Tressou-Cosmao *et al.* [3] quantified intake in fatty acids of the French population from INCA2 gross consumption data and updated CIQUAL nutritional profile tables, and a similar work was done by the ANSES [7] with very close results. In relation to the STD diet in our research (Table 1), SFA and C12:0-14:0-16:0 contents are lower in Tressou-Cosmao *et al*. [3] and ANSES [7] study by 13%. ALA content is higher by 7% and the LA/ALA ratio is 9.5 vs. 11.3, while DHA levels are equivalent (147 mg/d vs. 139 mg).

Table 1. Lipid intakes of STD and BBC diets and comparison to the french Population Reference Intakes (PRI)

	STD	BBC	PRI [6]	Contribution (%) [1]
Total caloric Intake (TCI, kCal/d)	2295			
Lipids (%TCI)	37.20		35-40	
SFA (%TCI)	15.98	14.71	<12	31.9
MUFA (%TCI)	12.89	13.79	15-20	12.7-42.7
PUFA (%TCI)	5.11	5.55		
n6-PUFA (%TCI)	4.21	4.29		
n3-PUFA (%TCI)	0.46	0.86		
LA (%TCI)	4.08	4.15	4	
ALA (%TCI)	0.36	0.65	1	45.1
EPA (mg)	82.6	117.9	250	21.0
DHA (mg)	139.2	187.9	250	43.9
C12-14-16 (%TCI)	10.53	8.72	<8	71.6

[1] Contribution (%) of the BBC diet to the reduction of gap between STD and PRI.

Despite these differences, which may potentially be due to the limited number of selected foodstuffs and the review of foodstuff fatty acids profile conducted for our study, all studies observe that the PRI are not reached in an average diet, in line with the present results. While certain strategies to reach the RDA focus on replacing foodstuffs by others, the approached used in this study acts only on the foodstuff

animal production method and more specifically feeding, without changing the foodstuff itself.

Even all the other PRI for fatty acids except for lipid are not reached whatever the menu, the impact of animal production systems is helpful. Indeed, BBC menu significantly increases ALA (+80%), EPA (+42.7) and DHA (+35%) intakes. Concomitantly, a reduction of atherogenic fatty acids (C12:0-14:0-16:0) intakes (-17.2%) and AGS (-7.9%) is observed. The BBC diet contributes to reducing the gaps between the content of STD diets and French PRI, the highest contributions being for atherogenic fatty acids (C12-14-16) (71.6%), ALA (45.1%), DHA (43.9%) and SFA (31.9%). Also of note, the European recommendations being lower as regards ALA, EPA and DHA [8], the change in production system enables EFSA recommended intake to be met for ALA, EPA and DHA, these recommendations being lower than the French PRI.

Dairy products act mainly on the intake of atherogenic fatty acids and SFA, whereas eggs acts on DHA intake (after fish which is the major contributor) and meat products on ALA and SFA intakes (Table 2). Each food group has a variable and complementary impact on the improvement in fatty acids content of the diet.

Dairy products predominantly affect the reduction in C12:0-14:0-16:0 intake (87.6%). Meat is responsible for a 72% increase in ALA intake, and eggs increase intake of DHA by 66%.

Table 2 Contributions of animal products in fatty acids intakes in STD and BBC diet. This table only present FA concerned by PRI.

	Lipids %TCI[1]		SFA %TCI		MUFA %TCI		LA %TCI		ALA %TCI		EPA mg		DHA mg		C12-14-16 %TCI	
	STD	BBC	STD	BBC	STD	BBC	STD	BBC	STD	BBC	STD	BBC	STD	BBC	STD	BBC
Milk products & Cheese	13,3		9,28	8,33	2,78	3,63	0,16	0,25	0,06	0,10	14,5	29,3	0,0	6,4	6,05	4,49
Fresh milk	0,32		0,22	0,20	0,07	0,09	0,00	0,01	0,00	0,00	0,3	0,7	0,0	0,2	0,15	0,11
Meat & meat products	9,75		3,72	3,45	4,15	4,18	0,83	0,84	0,07	0,28	13,9	30,9	9,0	18,8	2,59	2,37
Eggs	1,58		0,43	0,40	0,58	0,58	0,24	0,21	0,01	0,04	0,0	3,1	20,1	52,3	0,32	0,31
Fish	0,50		0,10		0,15		0,02		0,01		53,4		109,2		0,06	
Others [2]	11,74		2,22		5,16		2,83		0,22		0,50		0,99		1,37	

[1] TCI : Total Caloric Intake

[2] Others : all foodstuff excepted animal products (vegetable oils, fruits, vegetables, pasta, flour…)

Yet, considering the significance of animal products in the overall lipid intake (approx. 60% in the adult French population [3]), acting on production methods appears as a relevant and efficient way of meeting the objectives set by the French PRI. It is even sufficient to reach the objectives set by the EFSA [8] for ALA, EPA+DHA.

These strategies can also complement the use of plant products that offer interesting fatty acid profiles (replacing oils high in n-6 PUFA with oils high in n-3 PUFA (rapeseed or walnut in particular), the reduction in use of margarines and substitution with non-hydrogenated fats, or the introduction of flax flour in the diet. The increase in fish consumption is also required to reach the recommended DHA level, which is not met through the single change in production system for land animal.

IV. CONCLUSION

The present study demonstrates that improving the nutritional content of foodstuffs by changing the production system of animals has a significant impact on the daily average nutritional intake of consumers, and thus makes it possible to reduce the gap between recommended and real dietary intakes. More generally, consuming products from the BBC production system reduces from 12 to 70%, depending on the fatty acids considered, the gaps between average

intake and the French PRI. Consumption of products from this specific production system is thus an interesting lever to meet the nutritional objectives set by the ANSES. Consumption recommendations issued by the PNNS, in particular as regards consumption of fish, alongside consumption of animal products with improved fatty acid profiles, would be an interesting combination to improve the nutritional status of consumers, and would enable all French lipids PRI objectives to be met.

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