Revealing Nutrient Composition and Fatty Acid Diversity in Hybrid Products Combining Meat and Plant Protein

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I. INTRODUCTION

Consumers are increasingly interested in shifting towards diets with lower consumption of animal products (flexitarian) [1]. Reducing meat consumption is easier than completely excluding it from the diet by becoming vegetarian or vegan. Hence, hybrid meat products, in which a portion of the meat is replaced by sources of more sustainable protein, are highly attractive. This may bridge the gap between meat and meat-free products, allowing consumers to maintain their conventional use of food products [2]. The aim of the study was to investigate the effect of adding plant-based proteins on the fatty acid profile of hybrid meat products.

II. MATERIALS AND METHODS

Texturized pea protein (TPP 67C) was sourced from Agri Food Ingredients (N. G. Alexander & Co Pty Ltd, Melbourne, Australia). The TPP was rehydrated by mixing it with water at 90°C for 5 minutes at a 1:2 ratio (TPP: water, by weight), and subsequently cooled to room temperature (23°C ±1°C). The beef was coarsely ground using a mincer with a 4 mm diameter plate. The beef mixture was kneaded with salt, pork fat, and TPP for one minute each. After refrigeration, the meat patties were shaped into 150 g portions using a 10 cm patty maker. The composition of the hybrid formulas was as follows: Beef 61%; Hydrated texturized pea protein 20%; Pork fat 4%; Water 14.5%; Salt 0.5%. The composition of the control formulas was: Beef 81%; Hydrated texturized pea protein 0%; Pork fat 4%; Water 14.5%; Salt 0.5%. Three patties were selected randomly to test their chemical composition. Determination of crude protein followed the Leco Dumas method described in AOAC 992.15. A moisture, fat, and ash content were determined according to AOAC protocol (fat 920.39; moisture 925.09, ash AOAC 923.03). Determination of fatty acids composition of samples carried out according to the method described by Hastie et al. [3]. Statistical analyses were conducted using the statistical package PQStat version 1.8.4.152. The results in both groups were compared using the Student t-test for independent groups. A test probability of $p<0.05$ was considered significant, while a test probability of $p<0.01$ was considered highly significant.

III. RESULTS AND DISCUSSION

The proximate composition and fatty acid profile of the hybrid and control patties are shown in Table 1.

Table 1. The proximate composition and fatty acid profile of the hybrid and control patties

	Control product	**Hybrid product**
Water [%]	$74.52^{a}\pm0.24$	$73.18^{a}\pm0.18$
Protein [%]	$17.00^{b}\pm1.03$	$14.83^{a}\pm0.48$
Fat [%]	$7.38^{b}\pm0.47$	$5.51^{a}\pm1.18$
Ash [%]	$1.28^{a}\pm0.07$	$1.03^{a}\pm0.09$
Fatty acid profiles [%]		
Butanoic acid (C4:0)	$0.0091^{a}\pm0.001$	$0.0107^{b}\pm0.001$
Hexanoic acid (C6:0)	$0.0244^{a}\pm0.001$	$0.0528^{b}\pm0.001$
Heptanoic acid (C7:0)	$0.0702^{a}\pm0.003$	$0.1074^{b}\pm0.001$
Capric acid (C10:0)	$0.4818^{a}\pm0.034$	$0.4724^{a}\pm0.005$
Undecanoic acid (C11:0)	$0.0097^{a}\pm0.001$	$0.0093^{a}\pm0.001$
Lauric acid (C12:0)	$0.6233^{a}\pm0.029$	$0.6157^{a}\pm0.012$
Tridecanoic acid (C13:0)	$0.0398^{a}\pm0.001$	$0.0393^{a}\pm0.001$
Myristic acid (C14:0)	$7.4517^{b}\pm0.147$	$7.0235^{a}\pm0.096$
Myristoleic acid (C14:1)	$0.2529^{b}\pm0.002$	$0.2108^{a}\pm0.006$
Pentadecanoic acid (C15:0)	$1.1689^{b}\pm0.010$	$1.0927^{a}\pm0.018$
Palmitic acid (C16:0)	$40.6200^{b}\pm0.092$	$39.1601^{a}\pm0.183$
11-Hexadecanoic acid (C16:1)	$2.3144^{b}\pm0.026$	$2.1673^{a}\pm0.008$

Cis-10-heptanoic acid (C17:1)	$0.8367^{b}\pm0.002$	$0.754^{a}\pm0.010$
Stearic acid (C18:0)	$27.1786^{b}\pm0.247$	$25.8146^{a}\pm0.193$
Oleic acid (C18:1)	$4.8115^{b}\pm0.014$	$4.6224^{a}\pm0.024$
Linoleic acid (C18:2)	$6.6336^{a}\pm0.048$	$8.6588^{b}\pm0.060$
Linolenic acid (C18:3 n-6)	$2.5997^{a}\pm0.022$	$3.4444^{b}\pm0.016$
Linolenic acid (C18:3 n-3)	$1.5855^{a}\pm0.008$	$2.4295^{b}\pm0.002$
Arachidic acid (C20:0)	$0.685^{a}\pm0.002$	$0.8037^{b}\pm0.015$
11-Eicosanoic acid (C20:1 n-9)	$0.6803^{b}\pm0.004$	$0.6640^{a}\pm0.001$
cis-11,14-Eicosanoic acid (C20:2 n-6)	$0.3364^{a}\pm0.001$	$0.3393^{a}\pm0.006$
Heneicosanoic acid (C21:0)	$0.0155^{a}\pm0.001$	$0.0239^{b}\pm0.001$
Arachidonic acid (C20:4 n-6)	$1.1438^{b}\pm0.008$	$0.9048^{a}\pm0.016$
11,14,17-Eicosatrienoic acid (C20:3)	$0.1470^{a}\pm0.005$	$0.1520^{a}\pm0.003$
Decosanoic acid (C22:0)	$0.0883^{a}\pm0.001$	$0.1203^{b}\pm0.002$
13-Decosanoic acid (C22:1 n-9)	$0.0227^{a}\pm0.001$	$0.0426^{b}\pm0.002$
13,16-dcocasadienoic acid (C22:2)	$0.0670^{a}\pm0.006$	$0.0637^{a}\pm0.008$
Tricosanoic acid (C23:0)	$0.0054^{a}\pm0.003$	$0.0037^{a}\pm0.002$
Tetracosanoic acid (C24:0)	$0.0162^{a}\pm0.008$	$0.1015^{b}\pm0.001$
4,7,10,13,16,19-Docosahexaenoic acid (C22:6 n-3)	$0.0955^{b}\pm0.001$	$0.0798^{a}\pm0.001$
Sum of Saturated Fatty Acid (SFA)	**$75.34^{b}\pm8.22$**	**$72.53^{a}\pm7.93$**
Sum of Monounsaturated Fatty Acid (MUFA)	**$8.92^{b}\pm0.80$**	**$8.46^{a}\pm0.78$**
Sum of Polyunsaturated Fatty Acid (PUFA)	**$21.53^{a}\pm1.12$**	**$24.53^{b}\pm1.78$**

Results are expressed as mean ± standard deviation. Different lettering in the rows indicates significant differences $p<0.05$

The protein and fat content of the hybrid products are lower than that of the control samples. Furthermore, replacing meat proteins with pea protein isolate significantly modifies the fatty acid profile of the resulting products. The content of polyunsaturated fatty acids was higher in hybrid products compared to the control group (21.53% vs. 24.53%, respectively), while the content of saturated fatty acids was higher in the control group (75.34% for the control, 72.53% for the hybrid). Plant protein sources generally have a higher polyunsaturated fatty acid (PUFA) content compared to animal-derived products [4]. Consequently, the incorporation of pea protein led to a notable increase in PUFA content compared to the control samples. Completely different results were obtained by Flores et al. [5], who added coconut oil to hybrid meat patties as a fat substitute. They found an increased saturated fatty acid content while decreasing the content of mono- and polyunsaturated fatty acids compared to the meat product.

IV. CONCLUSION

In conclusion, hybrid products have a more favorable fatty acid profile than conventional meat products. The exception, however, could be a situation in which plant fats with a high content of saturated fatty acids (e.g., coconut or palm fat) are used to produce hybrid products. It is therefore recommended that when creating new products that will be beneficial to the health of the population, manufacturers and researchers pay attention not only to the type and quality of the protein they contain but also the quality of fat.

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