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2023 PADOVA, ITALY

ICoMST

69th INTERNATIONAL CONGRESS of MEAT SCIENCE AND TECHNOLOGY

Proceedings of the 69th International Congress of Meat Science and Technology

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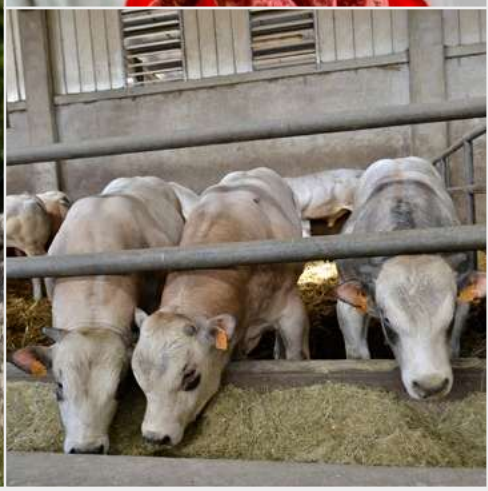

August 20-25, 2023

Padova, Italy

Edited by:

Antonella Dalle Zotte

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EFFECTS OF THE INCLUSION OF PROCESSED FORMER FOODSTUFF BASED ON BAKERY BY-PRODUCTS IN BROILER DIET ON FATTY ACID PROFILE AND CHEMICAL PROPERTIES OF MEAT

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I. INTRODUCTION

Sustainable meat production is a crucial in today's world and sustainable feed plays a vital role in achieving this goal [1]. The use of Former Foodstuffs (FFs) in animal nutrition represents a new area of research emerging from the principle of circular economy [2]. The estimated 5 million tons of FFs processed annually in Europe could be a resource [3]. Among FFs, bakery by-products (BBP) have been shown to be effective in ruminant [4] and swine diets [5]. However, there is a lack of research on its impact on poultry diets and meat quality. Therefore, the aim of this study was to investigate if the inclusion of BBP in broiler diet can affect the nutritional and quality traits of meat, including changes in fatty acid (FA) profile, oxidation and shelf-life.

II. MATERIALS AND METHODS

A total of 200 one-day-old male ROSS-308 chicks were divided into four iso-energetic and iso-nitrogenous dietary groups based on their average live weight (LW; 38.05 g ±0.11) (5 replicates/group and 10 birds/pen): Control (CTR: commercial feed), L-BBP (6.25% BBP), M-BBP (12.5% BBP), and H-BBP (25% BBP). BBP included as a substitute for corn-soybean meal. *In vivo* performance was evaluated throughout the trial. At day(d) 36, birds were slaughtered, and chicken breast samples (n=5/group) were taken for oxidation and shelf-life analysis at 5 different time points: d0 = (T1), d3 = (T2), d5 = (T3), d7 = (T4), d9 = (T5) during refrigerated storage (4°C±1). Lipid oxidation was measured as mg malondialdehyde (MDA/kg) muscle using the TBARS (Thiobarbituric Acid Reactive Substances) test [6]. Nitrogenous compounds in the meat were determined by calculating TVBN (Total Volatile Basic Nitrogen) was calculated according to Castrica *et al*. [6]. The FA profile of thigh and breast meat (n=5/group) was analysed using gas chromatography following Jia *et al*. [7]. Data were analysed using SPSS. A general linear mixed model compared the TBARS and TVBN based on two fixed factors (treatment, time, and their interaction). The FA data were tested using one-way ANOVA.

III. RESULTS AND DISCUSSION

The FA profile of breast and thigh meat showed a linear increase for saturated FA (SFA), monounsaturated FA and the ω-6 to ω-3 ratio, while polyunsaturated FA (PUFA) and the ratio of PUFA to SFA decreased linearly with increasing BBP levels ($P<0.05$) (Table 1). Meat FA results correspond to the FA profile of the feed due to fat components derived from raw materials in bakery production. However, the dietary inclusion of BBP and corresponding modification in FA profile had no effect on lipid oxidation of chicken meat at slaughter. The type of fat used in the diet and the presence of antioxidants may contribute to the observed results. As expected, the total values of TBARS (mg

MDA/kg) and TVBN (mg N/100 g) progressively increased (P<0.05) during the storage period (T1: 0.033, 14.36, T5: 0.498, 17.08, respectively). Notably, the H-BBP diet showed lower TVBN values (P<0.05), which can be attributed to its feed composition and potential impact on microbial growth in meat. This suggests that the degree of spoilage in H-BBP fed meat can be influenced by TVBN. Significant interactions between diet and storage time were observed for both TBARS and TVBN, indicating that the dietary treatment tested can affect meat quality and safety.

Table 1. Effect of BBP on thigh and breast meat fatty acid indexes

Fatty acid indexes	Samples	Dietary treatments				Standard Error	P- value
		CTR	L-BBP	M-BBP	H-BBP		
ΣSFA	Thigh	24.0	24.8	26.2	28.0	0.356	<0.001
	Breast	0.28	0.28	0.29	0.30	0.003	<0.001
ΣPUFA	Thigh	45.9	43.8	38.4	32.0	1.249	<0.001
	Breast	0.46	0.44	0.40	0.35	0.010	<0.001
Σω-6/Σω-3	Thigh	10.6	10.7	11.5	12.8	0.212	<0.001
	Breast	11.5	11.7	13.1	14.6	0.296	<0.001
ΣPUFA/ΣSFA	Thigh	1.91	1.77	1.47	1.14	0.069	<0.001
	Breast	1.66	1.60	1.37	1.14	0.048	<0.001

ΣSFA: Total saturated fatty acid, Σ PUFA: Total polyunsaturated fatty acid, Σω-6/Σ ω-3: Total omega-6/Total omega-3 ratio, ΣPUFA/ΣSFA: Total polyunsaturated fatty acid/Total saturated fatty acid ratio, CTR: Control feed, BBP: Bakery by-products, L-BBP: 6.25% BBP, M-BBP: 12.5% BBP, H-BBP: 25% BBP

IV. CONCLUSION

The results suggest that including BBP in broiler feed can modify the FA profile of the meat without affecting oxidation and can reduce TVBN values during storage. Further studies are needed to confirm these findings and promote sustainable poultry feeding practices.

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MEAT QUALITY AND SENSORY ATTRIBUTES OF MEAT PRODUCED FROM BROILERS FED DIFFERENT INCLUSIONS PERCENTAGES OF PROCESSED FORMER FOODSTUFF BASED ON BAKERY BY-PRODUCT

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I. INTRODUCTION

In recent years, the impact of meat production on the environment has sparked intense debate [1]. To tackle these challenges globally, innovative solutions are being sought, with alternative feed options playing a crucial role in promoting sustainable meat production [2]. In light of this, the use of former foodstuffs as sustainable ingredients in animal feed could be a promising alternative to cereal grains. Significant efforts have been made to recover the potential nutritional value of former foodstuffs that can no longer be used for human consumption [3,4]. Among them, bakery by-products (BBP) have been shown to be effective in ruminant and swine diets [5,6], but, their impact on poultry diets and meat quality remains largely unexplored [7]. Therefore, this study aimed to investigate the effects of BBP inclusions in broiler diets on the sensory attributes and physical characteristics of meat.

II. MATERIALS AND METHODS

A total of 200 one-day-old male ROSS-308 chicks were divided into four iso-energetic and iso-nitrogenous dietary groups based on their average live weight (LW; 38.05 g ±0.11) (5 replicates/group and 10 birds/pen): Control (CTR: commercial feed), L-BBP (6.25% BBP), M-BBP (12.5% BBP), and H-BBP (25% BBP). BBP included as a substitute for corn-soybean meal. At day 36, birds were slaughtered, and chicken breast samples (n=5/group: for each analysis) were taken and stored at −20˚C until shear force, drip loss, cooking loss, and sensory attributes were assessed. The sensory analysis involved two sessions: a discriminant analysis using a triangle test to compare the meat samples of the four groups. The number of correct judgments and their probability were calculated using a binomial distribution. An acceptability test followed, along with a descriptive assessment using the CATA method. Liking data from the acceptability test were analysed using one-way ANOVA and a two-way ANOVA model. The significance of discrimination among the four groups for each CATA attribute was determined using Cochran's Q test.

III. RESULTS AND DISCUSSION

No differences in shear force, drip loss and cooking loss results were observed between the groups. Discriminant analysis revealed that the results of the binomial tests showed no significant difference between dietary groups (Table 1). For our panel, the different inclusion levels of BBP in the broiler diet did not influence the perception of the final product, and there was no perceived difference between samples. Regarding the acceptability test and CATA questionnaire, liking scores showed no significant differences between samples and clusters of consumers. Results from Cochran's Q test on CATA attributes showed that only two attributes (Sour and Hard; $P<0.05$), were able to discriminate between

the groups. The multivariate exploratory analysis revealed tendential differences in sensory attributes among treatments. L-BBP and M-BBP groups were associated with "sulphurous," "salty," "umami," and "dry" descriptors, while the CTR group was linked to "tender" and "sweet" descriptors. The H-BBP group exhibited "hard" (CTR:7, H-BBP:14.49, P<0.05) and "fibrous" texture. These changes were influenced by protein and fat content in the diet, impacting muscle development and quality. However, BBP inclusion did not affect sensory profile or overall liking compared to the CTR group. Despite its high saturated fat content, the BBP diet showed no negative impact on meat quality, potentially due to factors like feeding duration, breed, age, and nutritional composition. Further investigation is needed to explore meat quality and nutritional composition.

Table 1. Effect of BBP on discriminant analysis

Samples	Number of Total	Number of correct Judgements	Number of incorrect Judgements	Minimum correct Judgements (P<0.05)	P- value
L-BBP vs CTR	24	7	17	<13	0.737
M-BBP vs CTR	24	4	20	<13	0.980
H-BBP vs CTR	24	3	21	<13	0.995

CTR: Control feed, BBP: Bakery by-products, L-BBP: 6.25% BBP, M-BBP: 12.5% BBP, H-BBP: 25% BBP

IV. CONCLUSION

Meat quality and sensory outcomes have a positive impact on consumers' sustainable meat choices, influenced by nutritional composition and carcass characteristics. Therefore, producers should communicate these benefits to increase awareness and demand, thereby, contributing to an environmentally conscious food system.

ACKNOWLEDGEMENTS

The authors from the Department of Veterinary Sciences at the University of Torino in Italy extend their gratitude to Dr. Danny Cliceri, Research Fellow at the Agriculture, Food, and Environment Center (C3A) of the University of Trento, as well as the "Sensory Quality" Research Group and all participating panellists for their valuable contribution to the sensory analysis.

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