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Effects of Replacing Palm Oil With Rapeseed Oil on Fatty Acid Concentration of Broiler Chicken

Sudharsan Chinnasamy[1*], Senthil Murugan S.[2] and Sanis Juliet[2]
[1]M.V.Sc., Department of Animal Nutrition,
College of Veterinary and Animal Sciences, Pookode, Wayanad (Kerala), India.
[2]Assistant professor, Department of Veterinary Pharmacology and Toxicology,
CVAS, Pookode, Wayanad (Kerala), India.

(Corresponding author: Sudharsan Chinnasamy)*
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ABSTRACT: Dietary fatty acid composition in broiler influences carcass quality by altering fat deposition and fatty acid profile. The quality of the fatty acids profile and the levels of various nutrients reflect the components of the rations provided to the birds. Thus the study was carried out to evaluate the effect of incorporation of rapeseed oil in broiler ration on fatty acid concentration of carcass in broiler chicken. A 160 day-old straight run broilers (Vencobb 400) chicks were randomly allotted into four treatment groups with four replicates of ten chicks each (G1, G2, G3 and G4). The basal diets (G1) were prepared to meet Bureau of Indian Standards nutrient requirements (IS 1374; 2007) included at the rate of 1.5, 3, and 4.5 per cent in pre-starter, starter and finisher ration, respectively. The experimental broiler rations prepared with rapeseed oil replacing 25, 50 and 100 per cent of palm oil in basal diets in treatment groups. Six birds were randomly selected from each group and slaughtered on 42nd day to study fatty acid concentration of carcass.Saturated fatty acid (SFA) concentration is significantly higher (P<0.01)in breast and thigh muscles in G1 group birds and lowest in G4 group. Whereas, concentration of poly-unsaturated fatty acid (PUFA) in G3 and G4 group thigh muscles were significantly higher than the G1 group. Mono unsaturated fatty acid concentration was not significantly affected between the groups. Incorporation of rapeseed oil in broiler ration increases deposition of PUFA content in the broiler carcass with no adverse effects.

Keywords: Broiler chickens, Fatty acid, Poultry, Rapeseed oil, Palm oil.

INTRODUCTION

In India, poultry industry had registered growth rate of 16.8 per cent and poultry meat production increased by 7.8 per cent according to 20th census (DAHD, 2020). The poultry nutritionists invariably incorporate various sources of oil (palm oil, mineral oil, rice bran oil) in broiler ration as energy source and to increase fat deposition. However, dietary fatty acid composition influences carcass quality by altering fat deposition and fatty acid profile (Abdulla *et al.,* 2015). The quality of the meat, the fatty and amino acids profile and the levels of various nutrients reflect the components of the rations provided to the birds. Awareness among human beings increased, to include polyunsaturated fatty acids (PUFA) in their diet to prevent diseases like coronary heart disease, hypertension and diabetes etc., (Bhalerao *et al.,* 2014) and inclusion of polyunsaturated fatty acids rich oil has shown to have beneficial effects on human health (Katan *et al.,* 1995). Improved fatty acid profile of chicken meat with higher n-3 fatty acids (FA) content could be possible by incorporating n-3 FA rich vegetable oils without affecting the carcass quality. The broiler is known to be an efficient food converter into high quality human food. In order to improve the fatty acid profile of chicken meat by increase higher n-3 fatty acids (FA) could be possible by incorporating n-3 FA rich vegetable oils without affecting the carcass quality. Palm oil is commonly used in broiler chicken nutrition; however, due to the environmental footprint, consumers have formed negative opinions regarding its applications. Therefore, alternatives to palm oil are urgently needed (Benzertiha *et al.,* 2019). The proposed study is to ascertain the fatty acid concentration of breast and thigh muscles by inclusion of rapeseed oil polyunsaturated fatty acid (PUFA) replacing saturated fatty acid rich palm oil at different proportions in broiler ration.

MATERIALS AND METHOD

Experimental details and data: The feeding experiment was conducted in Instructional Livestock Farm Complex, College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Science University, Wayanad, Kerala from the period of January to February 2019.One hundred sixty, day-old straight run Vencobb 400 broiler chicks purchased from hatchery were used and they were allotted into four treatment groups with four replicates of ten chicks each (G1, G2, G3 and G4) randomly.). The basal diets (G1) were prepared to meet Bureau of Indian Standards nutrient requirements (IS 1374; 2007) included at the rate of 1.5, 3, and 4.5 per cent in pre-starter, starter and finisher ration, respectively. The experimental broiler rations prepared with rapeseed oil replacing 25, 50 and 100 per cent of palm oil in basal diets in treatment groups.The ingredient composition of the experimental ration of broiler pre-starter, starter and finisher diet are presented in Table 1, 2 and 3. Feed and water were supplied *ad libitum* up to 42nd day of its age.

Slaughter study: Six birds were randomly selected from each group and slaughtered on 42nd day to study fatty acid concentration of carcass. Birds were euthanized by cervical dislocation. The cut-up part of collected breast and thigh muscle samples were weighed and stored in deep freezer at -20^{0}C for fatty acid analysis.

Table 1: Ingredient composition of broiler pre-starter feed, (%).

Ingredients	Groups			
	G1	G2	G3	G4
Maize	56.60	56.60	56.60	56.60
SBM	38.00	38.00	38.00	38.00
Palm Oil	1.50	1.13	0.75	0.00
Rapeseed oil	0.00	0.38	0.75	1.50
Salt	0.25	0.25	0.25	0.25
Shell grit	1.00	1.00	1.00	1.00
Di-calcium phosphate	1.60	1.60	1.60	1.60
Trace mineral[5]	0.10	0.10	0.10	0.10
Vitamin premix[6]	0.05	0.05	0.05	0.05
L-Lysine[1]	0.27	0.27	0.27	0.27
DL-Methionine[2]	0.15	0.15	0.15	0.15
L-Threonine[3]	0.05	0.05	0.05	0.05
Choline Cloride[4]	0.10	0.10	0.10	0.10
Feed additive[7]	0.33	0.33	0.33	0.33
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analytical values				
Metabolizable Energy (kcal/kg)	3025.48	3024.75	3024.27	3023.05
Crude Protein (%)	23.01	23.01	23.01	23.01

Table 2: Ingredient composition of broiler starter feed, (%).

Ingredients	Groups			
	G1	G2	G3	G4
Maize	58.15	58.15	58.15	58.15
SBM	35.10	35.10	35.10	35.10
Palm Oil	3.00	2.25	1.50	0.00
Rapeseed oil	0.00	0.75	1.50	3.00
Salt	0.25	0.25	0.25	0.25
Shell grit	1.00	1.00	1.00	1.00
Di-calcium phosphate	1.60	1.60	1.60	1.60
Trace mineral[1]	0.10	0.10	0.10	0.10
Vitamin premix[2]	0.05	0.05	0.05	0.05
L-Lysine	0.22	0.22	0.22	0.22
DL-Methionine	0.07	0.07	0.07	0.07
L-Threonine	0.04	0.04	0.04	0.04
Choline Chloride	0.10	0.10	0.10	0.10
Feed additive[3]	0.32	0.32	0.32	0.32
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analytical values				
Metabolizable Energy (kcal/kg)	3130.04	3128.58	3127.61	3125.18
Crude Protein (%)	21.80	21.80	21.80	21.80

Fatty acid analysis: The wet sample of breast and thigh musclefatty acid methyl ester (FAME) was synthesized by using direct method of FAME synthesis proposed by O'Fallon *et al*. (2007). Methyl ester composition of fatty acids was analysed by Gas Chromatography (GCMS-QP 2010 Ultra, Shimadzu, Japan) a flame ionization detector. The obtained spectrum of the sample was matched with the retention time of the individual fatty acids in the FAME standard mixture. From the detected fatty acids they are separated into saturated fatty acid (SFA), mono-unsaturated fatty acid (MUFA) and poly-unsaturated fatty acid (PUFA). Fatty acids were quantified as (%) of detected fatty acid.

Statistical Analysis: The obtained data in this experimental study on fatty acids were analyzed statistical methods described by Snedecor and Cochran (1994) using the software SPSS version 21.0 ®.

Table 3: Ingredient composition of broiler finisher feed, (%).

Ingredients	Groups			
	G1	G2	G3	G4
Maize	60.97	60.97	60.97	60.97
SBM	30.80	30.80	30.80	30.80
Palm Oil	4.50	3.37	2.25	0.00
Rapeseed oil	0.00	1.13	2.25	4.50
Salt	0.25	0.25	0.25	0.25
Shell grit	1.00	1.00	1.00	1.00
Di-calcium phosphate	1.60	1.60	1.60	1.60
Trace mineral[1]	0.10	0.10	0.10	0.10
Vitamin premix[2]	0.05	0.05	0.05	0.05
L-Lysine	0.20	0.20	0.20	0.20
DL-Methionine	0.06	0.06	0.06	0.06
L-Threonine	0.04	0.04	0.04	0.04
Choline Cloride	0.10	0.10	0.10	0.10
Feed additive[3]	0.33	0.33	0.33	0.33
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analytical values				
Metabolizable Energy (kcal/kg)	3234.16	3231.97	3230.51	3226.87
Crude Protein (%)	20.02	20.02	20.02	20.02

Table 4: Fatty acid profile of thigh and breast muscle fed with rapeseed oil and palm oil (per cent of fatty acid).

Fatty acid	GROUP				SEM	p-value
	G1	G2	G3	G4		
Thigh Muscle						
Saturated fatty acid (SFA)	40.498 ± 0.637[a]	27.096 ± 2.037[b]	21.227 ± 0.565[c]	17.796 ± 0.289[c]	2.653	0.000**
Mono-unsaturated fatty acid (MUFA)	28.375 ± 1.460	34.002 ± 2.584	29.482 ± 3.463	30.758 ± 1.222	1.191	0.417
Poly-unsaturated fatty acid (PUFA)	31.128 ± 1.682[b]	38.902 ± 3.279[b]	49.291 ± 4.029[a]	51.446 ± 1.503[a]	2.749	0.003**
Breast Muscle						
Saturated fatty acid (SFA)	25.653 ± 1.522[a]	22.068 ± 0.588[ab]	19.615 ± .082[bc]	15.549 ± 1.246[c]	1.254	0.005**
Mono-unsaturated fatty acid (MUFA)	37.510 ± 2.348	39.563 ± 1.524	40.286 ± 1.155	45.927 ± 4.320	1.466	0.214
Poly-unsaturated fatty acid (PUFA)	44.093 ± 1.868	45.516 ± 0.299	50.118 ± 1.651	46.559 ± 4.181	1.238	0.400

[a,b]and [c] Mean values with different superscripts within a row differ significantly

**Significance at p<0.01

RESULT AND DISCUSSION

Fatty acids concentration in thigh and breast and thigh muscle of broiler chicken supplemented with rapeseed oil and palm oil (%) is presented in Table 4.SFA and PUFA content in the breast and thigh muscle was significantly affected due to the oil source. Saturated fatty acid (SFA) concentration is significantly higher (P<0.01) in both thigh and breast muscles in G1 group birds and lowest in G4 group. Whereas, concentration of poly-unsaturated fatty acid (PUFA) in thigh muscles of G3 and G4 group were significantly higher than the G1 group birds (P<0.01). Mono unsaturated fatty acid concentration was not significantly affected between the groups. Similar to our findings, Benzertiha *et al.* (2019); Mech *et al.* (2021) reported that PUFA rich oil source in broiler feed improved PUFA concentration in the carcass. Skřivan *et al.* (2017) who used palm oil and rapeseed oil as vegetable oil source at 6 per cent in broiler diet reported that concentration of PUFA content was more in rapeseed oil fed group than palm oil group and concluded rapeseed oil significantly increased long chain fatty acids concentration in broiler birds carcass. In contrast, the diet supplemented with palm oil had the highest concentration of SFAs. Poudel,(2016) reported a similar finding on diet supplemented with rapeseed oil had the highest concentrations of unsaturated FAs. Kanakri *et al.* (2017); Saleha *et al*. (2021) who used different oil

sources (beef tallow, coconut oil, corn, flaxseed and canola oil) in the broiler diet and concluded that levels of fatty acids in diets correlated positively with the matching fatty acids. PUFA content was positively related to its content in the diet when the palm oil was replaced by PUFA rich linseed oil. Other researcher Valavan.*et al.*. (2016) reported that dietary incorporation of rapeseed oil at 3 per cent level recorded a significantly high level of total PUFA. In broilers, all tissues of poultry could be enriched with unsaturated fatty acids by increasing their per cent in the diet. The dietary fatty acids will be deposited without any modifications (Nieto and Ros, 2012).

CONCUSION

From the results of this study, incorporation of rapeseed oil in broiler ration increases deposition of PUFA content in the broiler carcass with no adverse effect which is a desirable character of consumer's preference. Thus, considering more availability and comparable cost of rapeseed oil, it is suggested that rapeseed oil could be included in broiler pre-starter, starter and finisher diet at 1.5, 3.0 and 4.5 % respectively as an energy source to increase PUFA composition which do favorable impact on consumer health.

FUTURE SCOPE

Future scope for this experiment can be carried out oil source in other species of poultry for it is recommendation.

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Conflict of Interest. none.

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