THE EFFECTS OF DIETARY RAPESEED MEAL EXTRACT AS AN ALTERNATIVE FEED RESOURCE ON GROWTH PERFORMANCE, CARCASS TRAITS AND MEAT QUALITY OF DUCKS

Purma-Adibelli, Çilem[1], Lautenschlaeger, Ralf[2]

[1] Ministry of Food, Agriculture and Livestock, Ankara, Turkey

[2] International Competence Center on Meat Quality, Max Rubner-Institut, Kulmbach, Germany

Abstract – In this study the effects of different levels of high glucosinolate rapeseed meal extract (RSME) on growth performance, carcass traits, chemical composition, physicochemical properties of breast and thigh muscles of 7 week old male Peking ducks were investigated. Ducks were fed with diets which contained 0%, 5%, 10% and 15% of RSME. For each experimental group 16 birds were selected randomly for further analysis. There were significant differences between groups with changing levels of RSME ($p<0.05$). A decrease in total breast meat/total weight and an increase in total thigh meat/total weight have been found with increasing levels of RSME in diets. Also abdominal fat ratio has been affected by RSME ($p<0.05$). There was no effect of graded levels of RSME on pH after slaughter; however there were slight effects on pH after chilling. Warner-Bratzler shear force values were also affected by RSME levels. 5% of RSME fed birds' breast meats have been found softer than other groups. Significant differences were found in physicochemical properties of duck meat (colour, cooking loss with thigh and breast, thaw loss of whole carcasses and TBARS values of thigh).

Key Words – Alternative feed resource, Carcass traits, Duck meat, Meat quality, Rapeseed meal

I. INTRODUCTION

In poultry nutrition soybean meal and maize are the most commonly used protein sources. In recent years global prices of these resources are variable and increasing day by day. Also the ban of the use of meat and meat-bone meal in poultry nutrition obligated the poultry producers to find out alternative feed resources which could substitute soybean and maize. Rapeseed meal is one of the alternative sources of protein which could be used in broiler diets. However an excessive level of rapeseed meal and thus high dietary glucosinolate content could lead to hypothyroidism, abnormalities in thyroid function and liver enzyme activity, and leg, liver and heart disorders [1]. There are many publications which use RSME diet (high or low in glucosinolate) in turkey and broiler chicken production, but limited information is available about the use of RSME in ducks. Therefore, more research is needed to understand the effects of RSME in duck feeds. The objective of the study was to find out the effects of different levels of high glucosinolate rapeseed meal extract (RSME) on growth performance, carcass traits, chemical composition, physicochemical properties of breast and thigh muscles of 7 week old male Peking ducks.

II. MATERIALS AND METHODS

Diets and Growth Trials

Diet batches were formulated to contain 0%, 5%, 10% and 15% of RSME (glucosinolate: 5,41 μmol/g) with starter diet (1-21 days) and grower diet (21-49 days). The composition and the calculated analysis of the diets are given in Table 1. At the end of trial all the birds were weighed. 192 male, one day old white Peking ducklings were grown to 49 days. All birds were kept in 8 tier batteries with free access to feed and water. Light was provided by light bulbs for 16 h regimen. Each feeding group had 48 birds. At the end of the feeding period, 16 of each group were randomly selected, slaughtered and chilled at 4 °C. The day after slaughter all carcasses had been frozen at –18 °C until required.

Table 1: The composition of starter and grower diets and calculated analysis results.

Starter Diet	0 %	5 %	10 %	15 %
Maize	250.00	250.00	250.00	300.00
Wheat	404.20	376.93	349.84	274.85
Soy oil	38.00	43.11	48.30	51.67
Premix	10.00	10.00	10.00	10.00
Calcium carbonate	12.41	12.77	13.11	13.47
Lysine HCl	4.93	3.87	3.00	2.50
Sodium chloride	4.00	3.99	3.99	3.96
Methionine	1.48	1.17	0.87	0.70
Soy flour %44	200.00	200.00	200.00	180.94
Soy HP	64.73	40.28	15.31	8.06
Dicalcium phosphate	7.58	6.04	4.51	3.04
Threonine	2.35	1.71	1.07	0.81
Tryptophane	0.32	0.13	-	-
Rapeseed extract	-	50.00	100.00	150.00
Dry matter	880.00	881.00	882.00	883.1
Crude protein	200.00	200.00	200.00	200.00
Crude fat	59.3	65.3	71.4	76.8
Crude fiber	30.9	35.5	40.2	44.1
Crude ash	61.0	61.2	61.5	61.4
Ca	8.5	8.5	8.5	8.5
P	5.0	5.0	5.0	5.0
ME, MJ	12.20	12.20	12.20	12.20
Lysine	11.6	11.6	11.8	11.6
Methionine	40	4.0	4.0	4.0
Methionine+Cystine	7.0	7.3	7.7	7.9
Tryptophan	2.1	2.1	2.1	2.2
Threonine	8.3	8.3	8.3	8.3
Linoleic acid	30.9	33.5	36.2	38.5
Grower Diet	0 %	5 %	10 %	15 %
Maize	300.00	300.00	300.00	300.00
Wheat	375.28	348.00	321.01	299.84
Soy oil	47.14	52.25	57.45	62.02
Premix	10.00	10.00	10.00	10.00
Calcium carbonate	15.81	16.17	16.04	15.50
Lysine HCl	4.69	3.63	2.74	2.95
Sodium chloride	2.67	2.67	2.66	2.64
Methionine	2.70	2.39	2.12	2.03
Soy flour %44	150.00	150.0	145.36	109.87
Soy HP	2.28	0.74	-	-
Dicalcium phosphate	1.19	0.55	-	-
Threonine	0.62	0.44	0.28	0.29
Tryptophane	87.62	63.16	42.34	44.86
Rapeseed extract	-	50.00	100.00	150.00
Dry matter	881.1	882.1	883.2	884.7
Crude protein	190.0	190.0	190.0	190.0
Crude fat	69.5	75.5	81.6	87.0
Crude fiber	28.5	33.6	38.1	41.6
Crude ash	56.1	56.3	56.8	57.3
Ca	8.5	8.5	8.5	8.5
P	4.0	4.0	4.1	4.4
ME, MJ	12.60	12.60	12.60	12.6
Lysine	10.0	10.0	10.0	10.0
Methionine	4.9	4.9	4.9	4.9
Methionine+Cystine	7.6	7.9	8.2	8.4
Tryptophan	2.1	2.1	2.1	2.1
Threonine	6.3	6.3	6.3	6.3
Linoleic acid	36.2	38.9	41.6	43.7

Carcass Traits and Meat Quality Measurements

The pH values after slaughter, chilling and defrosting were determined in duplicate using a portable pH meter (Knick Portamess 912 pH; Electrode SE 104; Knick Elektronische Messgeräte GmbH & Co. KG, Berlin, Germany). Abdominal fat was weighed and whole carcass weights were recorded after defrosting. Proximate analysis and hydroxyproline (%) were investigated [2]. To determine the cook losses of breast and thigh, they were heated in a water bath at 90 °C until 80 °C at midpoint were reached, and the results were calculated as % difference between cooked weight and initial weight. For thaw loss, whole carcasses were weighted before freezing and after defrosting. Then the % of difference between measurements / initial weights was calculated. Breast colour (L*, a*, b*) was measured using a Minolta Chromameter CR 300 from Konica Minolta, Munich, Germany. Five measurements per sample were taken and averaged. For understanding the oxidative stability of thigh muscles of ducks, TBARS analysis was used [3]. The Warner-Bratzler shear force value for breast muscles of ducks was determined with an Instron 1140 (company: Instron, Pfungstadt, Germany). Iodine analysis was carried out with an ICP-MS 7500 C (Agilent Technologies Deutschland GmbH, Böblingen) [4].

Statistical Analysis

For statistical calculations every bird was considered as a replicate. Normality and homogeneity of variance were calculated and data subjected to one way ANOVA with NCSS (2007) Software. Kruskal-Wallis and Tukey-Kramer tests were used when significant treatment effects were found. Treatment effects were considered to be significant when $P<0.05$.

III. RESULTS AND DISCUSSION

The average body weight (BW) of the ducks was significantly affected by increasing levels of RSME in diets ($p<0.05$). The results are compatible with the results of Thanaseelaan *et al.*, Tripathi *et al.,* Tuunainen *et al.* and McNeill *et al.*, for broilers [5,6,7,8]. These results are expected because of the high glucosinolate levels in RSME. Some of the researchers could not observe any differences between groups for broiler chickens, layers, turkeys or ducks [9,10,11,12]. Contradictory results possibly were due to the level of glucosinolates and tanins in RSME [5]. Thigh weight (TW)/body weight (BW) (%), breast weight (BW)/body weight (BW) (%) and abdominal fat/BW (%) were also significantly affected by levels of RSME in diets. Just 15% of RSME in the diet caused differences for breast muscle and thigh muscle proportions, however, some authors found a tendency to have differences [8, 12] and some of them found no significant differences for chicken and turkey [10, 11]. Abdominal fat was significantly affected by the RSME content of the diet. When RSME was increased abdominal fat decreased. According to Witak *et al.* diets with lupine and RSME had similar results as the control group but had a tendency to be lower in abdominal fat. Mikulski *et al.* found no significant differences between turkey groups fed with RSM [11].

Table 2 The effect of dietary levels of RSME on carcass traits and chemical composition of duck meat

	0 % RSME	5 % RSME	10 % RSME	15 % RSME
BW (g)	2133^{a}	1889^{b}	1697^{c}	1213^{d}
Thigh muscle %	15.98^{a}	16.41^{a}	17.58^{a}	21.34^{b}
Breast muscle %	18.53^{a}	19.52^{a}	18.15^{a}	14.95^{b}
Abdominal fat %	0.87^{a}	0.85^{ab}	0.41^{b}	0.19^{c}
Moisture (breast) %	75.53	76.02	76.09	74.74
Protein (breast) %	22.18	21.65	21.59	22.78
Fat (breast) %	1.34	1.61	1.42	1.44
Ash (breast) %	1.26	1.25	1.26	1.25
Hydroxyproline (breast)%	0.08	0.09	0.07	0.09

Means in rows marked with different letters differ significantly ($p<0.05$).

No significant differences were found in Minolta L* values, however a* and b* values were slightly affected by dietary RSME in diet. As demonstrated by Mikulski *et al.*, diets containing 180 g/kg RSM showed significantly higher contribution of yellowness of turkey breast meat [11]. No significant differences were found for pH after slaughter and after defrosting. However, the highest pH after chilling was found for the group fed with highest dietary level of RSME. Water holding capacity has been determined by measuring cook loss and thaw loss. For breast muscles cook loss results were found to have no significant differences. The cook loss for thigh muscles was highest in the control group ($p<0.05$). The lowest thaw loss was found at control group for whole carcasses. The inclusion of 120 g/kg RSM caused increased drip loss and 180 g/kg RSM in diet caused undesirable changes in cook loss for turkey breast meat [11]. Frozen samples defrosted after 3 days and thigh muscles were analyzed to detect the effects of RSME in diets on TBARS values. The 15 % RSME group showed the lowest TBARS values. This could be due to the antioxidative compounds which were found in rapeseed like sinapic acid and its derivatives [13,14]. Concerning the hardness results, the 5% RSME group was the softest one. This result is in accordance with Mikulski et al. [11]. There were no significant differences between groups for iodine values.

Table 3 The effects of dietary levels of RSME on physicochemical properties of duck breast and thigh meat

	0 % RSME	5 % RSME	10 % RSME	15 % RSME
L*	44.14	43.76	44.28	44.48
a*	14.08^{ab}	14.73^{a}	14.00^{ab}	13.44^{b}
b*	4.37^{a}	5.15^{ab}	4.64^{ab}	5.38^{b}
pH after slaughter	6.31	6.30	6.24	6.31
pH after chilling	5.56^{a}	5.57^{ab}	5.58^{ab}	5.62^{b}
pH after defrosting	5.67	5.65	5.68	5.68
Cook loss % (thigh)	23.00^{a}	16.70^{b}	17.73^{b}	17.95^{b}
Cook loss %	28.48	28.16	27.81	29.23
(breast)	2.02^{a}	2.94^{b}	2.85^{b}	2.42^{ab}
Thaw loss %				
(whole carcass)	0.12^{a}	0.11^{ab}	0.11^{ab}	0.10^{b}
TBARS (mg	27.09^{b}	25.13^{a}	26.82^{b}	27.82^{b}
MDA/kg)				
Warner-Bratzler				
shear force (N)				

Means in rows marked by different letters differ $p<0.05$.

IV. CONCLUSION

The use of high glucosinolate RSME in duck diets in the amount of 5%, 10% and 15% had effects on BW. Increasing levels of RSME in the diet decreased BW. This result is undesirable because of low feed conversion rates and consumer preferences. 10% and 15% of RSME caused a decrease in abdominal fat % which could be a reason for consumers to choose the product in the market. The high RSME in the diet contributed to an increase in oxidative stability of thigh meat which is desirable for a longer storage period. Water holding capacity was affected by RSME, the highest results for cook loss and thaw loss were found in control groups. Finally, the use of RSME in duck diets can be used at the level of 5% safely and economically. 10 % of RSME has positive effects on oxidative stability and water holding capacity of duck meats; however, it leads to lower BW which cannot be accepted by duck producers because of economic aspects.

ACKNOWLEDGEMENTS

Turkish Ministry of Food Agriculture and Livestock is gratefully appreciated for funding and supporting the 1st author. Max Rubner-Institut's International Competence Center is also appreciated for funding the project and providing technical support. The authors thank Dr. Ingrid Halle,Friedrich-Löffler-Institut, Institute of Animal Nutrition for her corporation and assistance.

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