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EFFECT OF THE LIPID SOURCE AND THE CEREAL USED IN THE DUCK DIET. GROWTH, SLAUGHTERING AND MEAT PHYSICAL TRAITS

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Summary

Two cereals (corn and sorghum) per two lipids sources (vegetable-oil and beef-fat) were used to formulate four different feed for mule ducks. Two hundred and thirty four mule ducks were reared in outside pens from 29 days and were slaughtered at 63 days old. Live weight, feed conversion efficiency, slaughtering traits, thigh-drumstick meat/bone ratio, skin with subcutaneous fat, colour of skin and meat, meat water retention capacity, and meat cooking losses for roasting at 70° and 90° C were measured. The results showed that: sorghum reduced live weight but improved conversion efficiency; animal fat improved the carcass look but increased incidence of the skin and decreased the live weights.

Duck - sorghum - fat - slaughtering - meat

Résumé

Effet des céréales et de la source des lipides dans les régimes pour canard mulard. Caractéristiques d'abattage et qualité de la viande.
On a utilisé 2 types de céréales (maïs et sorgho) et 2 sources de lipides dans la ration pour Mulard. 234 canards ont été abattus à l'âge de 63 jours et on a étudié les paramètres suivants : poids vif, efficacité alimentaire, caractéristiques d'abattage, rapport viande/os du membre postérieur, couleur de la peau et de la viande, capacité de rétention de l'eau et perte durant la cuisson au four à 70°C et 90°C. Le sorgho a entraîné un poids vif inférieur mais une meilleure efficacité alimentaire ; les lipides d'origine animale ont entraîné une augmentation de la quantité de peau et ont déterminé un poids vif inférieur.

Mulard - sorgho - graisse - abattage - viande.

INTRODUCTION

In human, the excess of saturated fatty acids in diet has been shown to increase the incidence of cardiovascular pathologies (Ulbricht and Southgate,1991) and, also for this reason, the physicians started to recommend to limit the consumption of red meat advantaging poultry meat. As a consequence, in the rich Countries, we observe, contemporaneously to a reduction of the per capita consumption of beef meat, a continuous increase of the per capita consumption of poultry meat. The dietetic quality of the carcass and especially of the meat as regard the quantity and quality of the fat are becoming more and more important also in

poultry and particularly in ducks. The composition of the diet used for duck feeding, and particularly the fat content and fat quality, can alter the slaughtering traits and the carcass quality (Fisher C., 1988; Holsheimer J.P., 1991; Olivetti and Gualtieri., 1990; Scaife et al., 1994; Scerra et al., 1990). Nutritionists were used to improve the poultry performances by adding animal fats to feed. The use of fat, not only increases the ME of the diet but improves the consistency of the skin with subcutaneous fat, the stability of adipose tissues, the storage life and, as a consequence, the appearance of the processed carcasses (Hartfiel W., 1995). The use of oil, which can perfectly replace fat from an energetic point of view, might improve the meat dietetic quality but can worse the stability of the adipose tissues and the consistency of the skin with subcutaneous fat with the consequence worsening of the appearance of the processed poultry carcasses (Wu et al., 1994; Zollitsch et al., 1992).
For these reasons we studied in a 2 x 2 factorial design the productive performance and the carcass characteristics of growing mule ducks fed four diets differing in the cereal basis of the diet (corn and low tannin sorghum) and in the fat addition (beef fat and vegetable oil).

MATERIALS AND METHODS

For the trial we used 234 "mulards" (mule ducks Cairina moschata*Anas plathyrhynchos). The ducks were reared in a windowless poultry house from day old to 28 days old, then in outside pens at a density of 5 birds/m² till the slaughter, carried out at 63 days.
The one day old ducklings were randomly divided into twelve pens (three pens per diet) and every duckling of the same pen received ad libitum the same experimental diet for all the rearing period. Each experimental diet was differently formulated for the starter (1-42 days) and the finisher period (43-63 days) (Tables 1 and 2). The diets used, isoproteic and isoenergetic and with the same total amount of fat added, were the followings:

	Vegetable oil	Beef fat
Corn	C-VO	C-BF
Sorghum	S-VO	S-BF

Live weight was recorded individually, feed consumption and feed conversion efficiency were recorded per pen. At the slaughtering age 15 animals per group (5 ducks per pen) were used to record the following weights: warm eviscerated duck (dry plucked and bled duck with neck, head, shanks, and without crop, oesophagus and the complete abdominal content), gastrointestinal tract, chilled eviscerated duck (after 24 h cooling at 4°C and 70% R.H.), tail with preen gland, abdominal fat, ready to cook carcass, skin with subcutaneous fat, wing with skin, thigh-drumstick with skin, and wasting carcass (Working Group V WPSA, 1984). The colour was determined on the skin of the right apterilium zone on the breast and on the surface of the breast muscle by Minolta colorimeter (mod. CR210) (Pagano Toscano, 1988). The breast was then used for the water holding capacity, and the roasting tests; the left leg was used to determine the meat to bone ratio. The water holding capacity was measured on a 300 mg sample (according to Grau and Hamm, 1957) and expressed as ratio between meat area and total area (Hofman et al., 1982; Honikel, 1987). The roasting tests were carried out at 70°C and 90°C: samples were placed on the net floor of an electric oven pre-heated to 165° ± 5°C., a thermocouple was inserted into the muscle (60 ± 5g) to record the internal temperature and the samples were removed (for weighing after 30' cooling) from the oven after the temperature has reached 70° or 90°C.
Collected data were analysed by Anova (Wilkinson, 1988).

RESULTS

Significant differences were observed in the growth performances and the slaughtering traits in relationship to the treatments but, since the hidden effect (interaction) was never significant, only the principal effects are discussed.
Ducks fed the corn based diet were heavier ($p<.05$) and consumed more feed ($p<.01$) than duck fed the sorghum based diets (Table 3). The feed conversion ratio was not increased in the sorghum based diets but significantly improved ($p<.01$). The use of vegetable oil in the diet improved the live weight ($p<.01$) and increased the feed intake ($p<.01$) with no significant effect on the feed conversion ratio. Regarding the effects on the slaughtering traits (Table 4), the sorghum based diets induced better eviscerated weights ($p<.01$). The data was not explained by the decrease of the development of the gastro-intestinal tract, induced by the reduction of daily intake due to the astringent taste of the diet containing sorghum. The increased incidence of the eviscerated weight size observed in the duck fed the sorghum based diets was due to an increased incidence of the shanks and of the wasting carcass ($p<.05$). No difference was observed for the breast muscles incidence and the percentage of left thigh with drumstick was lower (significantly high) in the ducks fed the sorghum based diets. Regarding the source of fat used in the diet, no difference was observed between the chilled eviscerated traits. On the eviscerated ducks, the skin with subcutaneous fat incidence was increased by the use of beef fat in the diet ($p<.01$); contemporaneously the incidence of the first quality cuts decreased (even if not significantly) and the wasting carcass ($p<.01$) with the shanks ($p<.05$) increased. The effect of the experimental diets on colour and meat quality are shown in Table 5. The colour of the skin in the ducks fed the sorghum based diets was more pale than in the ducks fed the corn based diets. The yellow component (b* value) and the saturation of the yellow (C* value) in fact was high significantly more "yellow" in the corn fed ducks. Also the use of beef fat improved the saturation of the colour which was more yellow ($p<.01$).
Regarding the colour of the surface of the breast muscles, the presence of sorghum in the diet seems to be related to a relative increase of the red and decrease of the yellow components, even if with a simultaneous decrease of the hue ($p<.05$). No difference was induced on the colour of the surface of the breast muscles by the different source of the fat added to the diets. The water holding capacity was significantly higher in the duck fed the corn based diets according to the higher slaughtering weight while the cooking loss did not reach the minimum statistical difference both at 70°C and at 90°C.

DISCUSSION

The use of sorghum in the diet even if with a low tannin content showed a consistent effect on feed intake, probably in relationship to the astringent taste of the pelleted feed (Nyachoti C.M. et al., 1997). Since the tannin content was very low, the presence of tannins did not reduce the protein availability (DL metionine had been added) and the digestive enzyme activity, so that the reduction of feed intake improved the feed conversion efficiency. The ducks fed ad libitum with corn based diets are inclined to consume feed in excess, so that a feed restriction is often advised (Elkin R.G., 1987; Farrell D. J., 1991). The increase in unsaturated fatty acids in the diet (with no oxidised fatty acid content), improved both live weight and feed intake. The process of production of beef fat in fact could determine the presence of water and iron traces and the temperature used for the water evaporation from the beef slaughtering residues is higher than the temperature used to evaporate the solvent from the oil extracted from seeds,

so that traces of oxidised fatty acids can be found more easily in the beef fats, even if these fats are not easily decomposed in relationship to the fatty acids composition (Piccioni M., 1989).
The slaughtering traits are probably influenced by the lighter weight of the ducks and the lower daily intake induced by the sorghum based diets. So the improvement of the eviscerated weight percentage on the live weight might be explained by a fault of plumage and a reduction of the incidence of the gastrointestinal tract on the live weight. The lighter weight of the ducks might also explain the tendency to a reduction of the incidence of wing, thigh, drumstick, and breast muscles, characterised by a late growth (Romboli I., 1980).
The skin and the surface of the breast muscles were less yellowish in the sorghum fed ducks in relationship to the absence of xanthophyll in the sorghums which allowed a production of less pigmented ducks. The skin showed a better look but a greater incidence in the ducks fed with the diets added with the beef fat. No oil smearing aspect of the carcasses was observed in the ducks fed with the oil added diets, probably also for the slaughtering technique usually applied to ducks (dry plucking then wax treating instead of hot wet plucking).
The higher water holding capacity and cocking loss observed in the ducks fed with the corn based diets are unclear. The increased water holding capacity, observed in the ducks when the oil is used to increase ME of the diet, might be explained by a better meat quality confirmed by the tendency to higher oil dropping in the roasted meat.

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Table 1. Diet compositions used in the trials.

INGREDIENTS	STARTER Diet (1-42 d)				FINISHER Diet (43-63 d)			
	C-VO	C-AF	S-VO	S-AF	C-VO	C-AF	S-VO	S-AF
Corn..... %	65.00	65.00	---	---	71.00	71.00	---	---
Low tannin sorghum..... "	---	---	66.50	66.50	---	---	72.50	72.50
Soybean meal (44%)..... "	26.50	26.50	25.50	25.50	14.50	14.50	13.50	13.50
Shorts wheat..... "	3.10	3.10	1.35	1.35	3.90	3.90	3.75	3.75
Alfalfa meal (17%)..... "	---	---	---	---	4.00	4.00	2.50	2.5
Dicalcium phosphate..... "	1.50	1.50	1.50	1.50	1.60	1.60	1.60	1.60
Calcium carbonate..... "	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sodium chloride..... "	.25	.25	.25	.25	.25	.25	.25	.25
DL-methionine..... "	.15	.15	.25	.25	.15	.15	.30	.30
L-Lysine..... "	---	---	.15	.15	.10	.10	.20	.20
Premix *..... "	.50	.50	.50	.50	.50	.50	.50	.50
Vegetable oil..... "	2.00	---	3.00	---	3.00	---	4.00	---
Animal fat..... "	---	2.00	---	3.00	---	3.00	---	4.00
Metabolizable energy.. MJ/Kg	12.30		12.32		12.73		12.80	
Protein..... %	18.50		18.49		14.71		14.74	
Fat..... "	5.11		5.29		6.39		6.52	
Crude fibre..... "	3.54		3.56		3.86		3.67	
Ash..... "	5.69		5.58		5.60		5.38	

*Per kilogram of diet: vitamin A 8,000 IU; cholecalciferol 2,000 IU; vitamin B1 1.5 mg; riboflavin 3 mg; vitamin B6 1.5 mg; vitamin B12 15 µg; D-α-tocopherol acetate 7.5 IU; menadione sodium bisulfite 1.5 mg; niacin 25 mg; D-pantothenic acid 8 mg; choline chloride 500 mg; Co 0.2 mg; Fe 30 mg; I 1.4 mg; Mn 80 mg; Cu 1.5 mg; Zn 30 mg.

Table 2. Chemical composition (as feed basis) of corn and low tannin sorghum

	Corn	Sorghum
Crude protein.....%	8.35	13.20
Ether extract.....%	3.62	2.42
Crude fibre.....%	2.88	3.62
Ash.....%	1.18	2.01
N-free extract.....%	71.95	66.73
Starch (polarimeter - EEC method).....%	64.15	53.80
Total reducing substances(glucose equivalent - EEC method)..%	1.40	.25
Total tannins(catechin equivalents - EEC method).....%	-	.89

Table. 3. Effect of diet on productive performance of mule ducks.

	CORN	SORGHUM	OIL	BEEF FAT
	mean s.d.	mean s.d	mean s.d	mean s.d
Live weight	3600a ± 319	3529 ± 262	3636A ± 310	3494B ± 260
Feed intake.....g/da	215A ± 14.3	188B ± 5.5	208A ± 22.6	195B ± 7.3
Feed conv. ratio	3.2A ± 19	2.8B ± 17	3 ± 4	3 ± 16

Note: means with different letters are significantly different (capital letters p<.01, cursive letters p<.05).

Table. 4. Effect of diet on slaughtering traits of mule ducks.

	CORN	SORGHUM	OIL	BEEF FAT
	mean s.d	mean s.d	mean s.d	mean s.d
Slaughtering l.w.(1)	3644a ± 157	3472b ± 99	359 ± 178	352 ± 126
Gastrointestinal tract.....% (1	4 ± 44	3 ± 50	3.8 ± 51b	4.1a ± 43
Chilled eviscerated duck (2) % (1	74.5B ± 1.56	75.7 ± 1.28	75 ± 1.71	75 ± 1.44
Abdominal fat % (1	1 ± 45	1 ± 41	1 ± 41	1 ± 45
Shanks.....% (2	3.2b ± 22	3.4e ± 18	3.2b ± 20	3.4a ± 20
RCC % (2	83.9 ± 1.09	83.2 ± 1.08	83.6 ± 1.13	83.5 ± 1.13
Left wing % (2	5.8 ± 42	5 ± 45	5.9A ± 34	5.5B ±25
Left thigh-drumstick % (2	11.2A ± 69	10.6B ± 72	10.9 ± 75	10.8 ± 74
Breast muscles % (2	13.5 ± 1.65	13.2 ± 1.40	13.5 ± 1.51	13.2 ± 1.57
Skin with subcutaneous fat % (2	18.7 ± 3.04	19.6 ± 2.42	17.9B ± 2.58	20.4A±2.39
Wasting carcass % (2	17.8b ± 1.49	18.5a ± 1.02	17.5b ± 1.23	18.7A±1.11
Meat/bone of thigh-drumstick	4.7 ± 37	4.8 ± 44	4.8 ± 38	4.7 ± 43

Note: means with different letter are significantly different (capital letters p<.01, cursive letters p<.05).

Table. 5. Effect of diet on skin colour and breast muscles characteristics of mule ducks.

	CORN		SORGHUM		OIL		BEEF FAT	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Skin								
L* (lightness)	75	±2.0	76	±2.2	75	±2.2	75	±2.1
a* (redness)	2.9	±1.39	3.4	±1.41	3.2	±1.13	3.2	±1.66
b* (yellowness)	22.5A	±3.18	13.8B	±3.21	17.1B	±5.26	19.3A	±5.38
C* Saturation)	23A	±3.2	14B	±3.3	17B	±5.3	20A	±5.2
H* (hue)	82A	±3.4	74B	±13.0	76	±13.5	80	±5.9
Breast								
L* (lightness)	47	±5.8	46	±3.5	47	±3.2	47	±5,9
a* (redness)	12.5b	±2.70	13.6a	±1.23	13.5	±1.18	12.6	±2.73
b* (yellowness)	4.1a	±3.40	2.7b	±.92	3.3	±.91	3.5	±2.5
C* Saturation)	14	±2.1	14	±1.2	14	±1.2	14	±2.1
H* (hue)	18a	±13.8	11b	±4.1	13	±3.8	15	±14.5
Water holding cap.	.35A	±.087	.31B	±.033	.35A	±.080	.31B	±.050
Cooking loss 70°C %	20.9	±2.78	19.2	±2.37	20.3	±2.26	19.9	±2.77
Cooking loss 90°C %	37.2	±2.46	36.9	±3.39	37.4	±3.3	36.7	±3.01

Note: means with different letter are significantly different (capital letters $p<.01$, cursive letters $p<.05$).