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EFFECT OF FORCE-FEEDING ONFATTY LIVER AND SERUM BIOCHEMICAL PARAMETERS IN MULE DUCKS

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Abstract

A study on the changes of body weight, liver and blood serum biochemical parameters - L-aspartat-2-oxoglutarat aminotransferase, alanine aminotransferase, alkaline phosphatase, γ-glutamyltransferase, total cholesterol, triglycerides and creatinine of male and female mule ducks before and after force-feeding was carried out. The force-feeding of ducks with maize was taken after 74-days of age and continued 13 days. During force-feeding period, the body weight increased with 47.25% in males (from 3983±133.85 g to 5865±212.33 g) and with 38.06% in female ducks (from 3450±215.06 g to 4763±87.73 g). The liver weight increased 7.53 times in males (from 82±5.40 g to 600±22.86 g) and 5.65 times in females (from 77±4.81 g to 435±46.79 g). After 13 days of force-feeding significantly increased the blood serum concentration of alanine aminotransferase ($P<0.05$ in males and $P<0.01$ in females), total cholesterol ($P<0.001$ in both sexes) and triglycerides ($P<0.001$ in both sexes), and decreased of γ-glutamyltransferase ($P<0.01$ in males and $P<0.05$ in females), and creatinine ($P<0.01$ in males and $P<0.001$ in females).

Key words: *biochemical parameters, blood serum, fatty liver, force-feeding, mule duck.*

INTRODUCTION

Under natural conditions, hepatic steatosis occurs in wild *Palmipedes* as a consequence of energy storage before migration. In poultry production, this specific capacity is used for the production of commercial fatty liver (foie gras). In response to overfeeding, *de novo* hepatic lipogenesis is dramatically increased, however, all triacylglycerols (TG) do not enter the secretion pathway, and a large proportion remains stored in the liver and is responsible for *in situ* steatosis (Hermier et al., 1991; 1999 a). Susceptibility to hepatic steatosis in waterfowls in response to overfeeding depends not only on the species, but also on the breed (Poujardieu et al., 1994; Hermier et al., 1999 a). Certain genotypes may be more responsive to the dietary induction of fatty liver because of a less efficient channeling of hepatic lipids towards secretion into plasma and adipose storage, and the duck may represent a suitable model in which to study the development of hepatic steatosis and its pathogenesis (Hermier et al., 2003).

Over the past few decades, the mule ducks are most offen used for production of foie gras, which are an inter-generic infertile hybrid between the muscovy drake and the female common duck (Gerzilov, 2003; Guemene and Guy, 2004; Marie-Etancelin et al., 2008). The reciprocal hybrid named hinny duck (common drake $_{x}$ muscovy duck) offers no interest in animal breeding (Brun et al., 2005). In the present, Bulgaria occupies the second world rank after France for fatty liver production from mule ducks estimated at 2300 tons annually (Gerzilov, 2013).

MATERIALS AND METHODS

The study was carried out at the duck farm for producing fatty liver of region of Haskovo in the period from October 2011 to January 2012. The male (n=2910) and female (n=2690) growing mule ducks (from 0 to 74 days of age) were housed separately (in two groups) on straw deep-litter system in barn with yards for walk (after 28 days of age). All birds were fed *ad libitum* diet consists ME-11.87 MJ/kg and CP-19.70% during the starter period (0-28 days of age) and diet consists ME-11.30 MJ/kg and CP-17.24% during finisher period (29-74 days of age). After that during 13 days ducks from both groups were force fed with maize.

The body weight of 6 birds from each group before and after force-feeding was measured by electronic balance in g. The serum biochemical

analysis was taken before and after force-feeding from the same birds. The blood was allowed to clot for two hours at room temperature (20°C) and the samples were centrifuged at 2000 g for 10 min.

Blood serum alanine aminotransferase (ALAT), aspartate aminotransferase (ASAT), γ-glutamyl transferase (γ-GT), alkaline phosphatase (APh), total cholesterol (Chol), triglycerides (TG), and creatinine (Creat) were determined with an automated biochemical analyzer BS–120 Mindray at an accredited biochemical lab "Provet" - Plovdiv.

For the purpose of histological investigation pieces from the central part of right lobe of the liver were taken with the following dimensions: 1/1/1 cm. The liver pieces were immediately put into 10% formalin, included in paraffin and cut with microtome. The sections with 5-6 μm thickness were stained in hematoxylin - eosin. The observation was carried out by Jenaval microscope.

RESULTS AND DISCUSSIONS

After 13 days force-feeding with maize, growth performance of male mule ducks increased with 1882 g ($P<0.001$) i.e. with 47.25%, while in female mule ducks were with 1313 g ($P<0.001$) i.e. with 38.06% - Table 1.

Table 1. Body weight and slaughter analysis of mule ducks before and after force-feeding

Indices		Males		Females	
		Before force-feeding	*After force-feeding*	*Before force-feeding*	*After force-feeding*
		x±Sx	x±Sx	x±Sx	x±Sx
Body weight	g	3983±133.85 a_1	5865±212.33 a_1	3450±215.06 a_2	4763±87.73 a_2
Carcass yield	g	2470±83.37 a_3	3161±86.48 a_3	2230±140.89 c_1	2598±25.22 c_1
	%	62.01	53.89	64.64	54.53
Liver	g	82±5.40 a_4	600±22.86 a_4	77±4.81 a_5	435±46.79 a_5
	%	2.05	10.23	2.24	9.13
Breast muscule (magret)	g	612±37.80 b_1	784±26.26 b_1	547±42.62 c_2	658±8.66 c_2
	%	15.36	13.36	15.85	13.80
Drumsticks (thighs and shank)	g	263±10.80 a_6	746±23.38 a_6	253±24.83 a_7	568±42.52 a_7
	%	6.61	12.72	7.34	11.91

Note: The difference are significant in the row at: $P<0.05$ – c_1-$c_{1....C2-C2}$; $P<0.01$ – b_1; $P<0.001$– a_1-a_1….a_7-a_7.

As a result of the hepatic steatosis (Babile et al., 1996; Benard et al., 1998; Hermier et al. 1999 b; Baeza et al., 2005), the weight of liver was increased 7.32 times in males and 5.65 times in females.

Histology observation showed that in the cytoplasm of hepatocytes there were no signs of fatty degenerations (Figure 1) after the end of 74th day-period. After 13 days of force-feeding the whole cytoplasm of all hepatocytes contained many fatty droplets in different size (Figure 2).

The liver weight in relation with body weight was increased from 2.06% to 10.23% in males and from 2.23% to 9.13% in females at the end of over feeding period.

The weight of drumsticks (thighs and shanks) significantly increased from near to 2.84 times in males and 2.26 times in females.

There are significant increases of the breast muscle and leg weights, as well as carcass yield after force feeding, but the percent of carcass yield versus body weight decreases at both groups - with 8.21% for the males and with 10.11% for the females. In our opinion it is because of increasing the weight of internal organs, especially these from digestive system and the presence of residual amount of the maize in the tract.

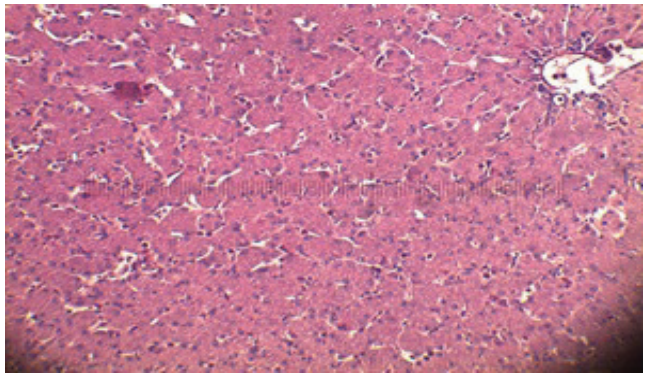

Figure 1. Liver before force-feeding, H/E, 12.5x

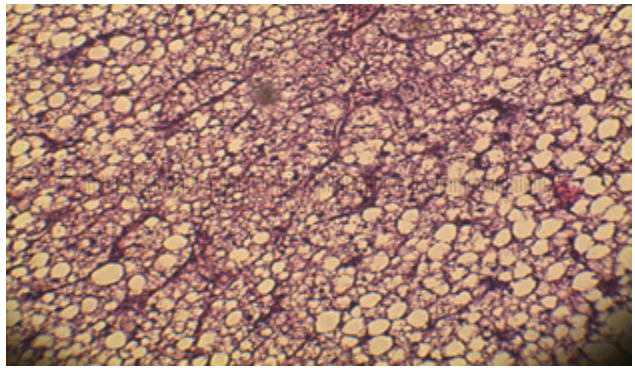

Figure 2. Liver after force-feeding, H/E, 12.5x

Force-feeding significantly (P<0.05) increased the serum concentration of alanine aminotransferase (ALAT), triglycerides (TG) and total cholesterol (Chol), and decreased γ-glutamyl transferase (γ-GT), and creatinine (Creat) - Table 2. Zhu et al. (2010) established a similar trend of change of these parameters in experiment with overfeeding of Landes geese. In their view, the increase of serum enzyme indicated that the liver was significantly destroyed in response to overfeeding. Wen et al. (2011) found that serum triglycerides, cholesterol concentration and glutamate pyruvate transaminase activity were significantly increased with the increasing of force-feeding amount at male Pekin ducks for period from 35 to 42 days of age.

The serum aspartate aminotransferase (ASAT) and alkaline phosphatase (APh) also increased (P>0.05). Significant differences of serum parameters were not found in comparing the both sexes before (except ALAT) and after force-feeding, respectively.

Table 2. Blood serum biochemical parameters

Parameter	Males		Females	
	Before cramming	*After cramming*	*Before cramming*	*After cramming*
	x±Sx	*x±Sx*	*x±Sx*	*x±Sx*
ASAT, *U/L*	69.90±23.53	115.86±10.84	65.93±14.28	108.93±19.37
ALAT, U/*L*	45.17±16.26 c_1	101.06±7.50 c_1	25.03±9.45 b_1	115.55±21.63 b_1
APh, *U/L*	405.33±54.71	571.63±79.68	343.33±27.58	484.50±66.88
γ-GT, *U/L*	6.27±0.29 b_2	4.53±0,24 b_2	5.50±0.53 c_2	4.48±0.67 c_2
TG, *mmol/L*	5.41±0.39 a_1	11.16±0.53 a_1	4.94±0.34 a_2	11.65±0.47 a_2
Cholesterol, *mmol/L*	1.09±0.25 a_4	7.72±0.58 a_4	1.47±0.18 a_5	8.36±0.40 a_5
Creatinine, *μg/L*	23.77±2.37 b_3	15.93±0.91 b_3	28.67±0.76 a_6	15.98±1.76 a_6

Note: The difference are significant in the row at: P<0.05 - c_1-c_1, c_2-c_2; P<0.01 - b_1-b_1… b_3-b_3; P<0.001- a_1-a_1...a_6-a_6

CONCLUSIONS

After 13 days force-feeding the body weight increased with 47.25% and the liver weight with 7.53 times in male mule ducks and with 38.06% and 5.65 times in female mule ducks respectively.

After the force-feeding the hepatocytes showed signs of hepatic steatosis.

Significantly increased the serum concentration of alanine aminotransferase, total cholesterol and triglycerides, and decreased of γ-glutamyltransferase and creatinine in both sexes.

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