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The Effect of Force-Feeding, Fasting and Glucose Saturated Water Intake on the Contents of Some Biochemical Parameters in Plasma of Peking Ducks

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Abstract: This experiment was conducted to evaluate the accuracy of a bioassay method for metabolizable energy for domestic duck, which was previously developed by our research group. 110 adult Peking drakes with similar weight were randomly allotted to 2 groups in each of 55 birds, one was treatment group and another was control group. Prior to trial, all birds were fasted for 12h, but water were provided *ad libitu*m. And 5 birds from each group were web-bled from their venous in wings. At the same time, each bird of the tow groups was force-fed by pelleted feed 50g, then they were fasted but water was provided *ad libitu*m. 4h later, drakes of the trial group were intake glucose saturated solution once every 6h for 15 minutes. At 2h, 12h, 24h, 36h, 48h after force-feeding, ten birds from each group were web-bled and discarded, respectively. Contents of glucose, uric acid, total protein, triglyceride, insulin, triiodothyronine, corticosteroid in plasma were measured. The results indicated that contents of glucose, uric acid and total protein in plasma didn't fluctuate during the starvation of 48h. However, the content of triiodothyronine in plasma tended to decline, but it showed nonsignificant ($p>0.05$). Therefore, those drakes weren't in abnormal conditions. Feeding glucose saturated solution to fasted drakes could alleviate the decrease of triiodothyronine in plasma. Fast resulted in the decease of insulin content in plasma. The plasma insulin content of fasted drakes fed glucose saturated solution is steady. Force feeding and fast didn't cause the change of the corticosteroid content in plasma, which indicated that forementioned treatments didn't make ducks under stress.

Key words: Duck, fast, force-feeding, biochemical parameters

Introduction

The bioassay method of true metabolizable energy for chicken feedstuffs which was developed by Sibbald (1976) had been accepted as a relatively feasible method. The trial birds must suffer from fast and force-feeding, which may affect the accuracy of the method. Force-feeding and fast may caused strong stress and damaged digestive system to birds (NRC, 1994). But there is no direct evidence to support it.

Although Chamblee *et al*. (1982,1983,1989) reported that short time (12h) fast had no effect on contents of broiler serum protein, sodium and potassium which indicated that short time fast didn't resulted broilers in abnormal state, the effect of the longer time (>12 h) is unknown. In feed metabolizable energy bioassay, the birds must be fasted for more than 12 h to clear the residues from feed and its effects should be considered to ensure accuracy of the method. Through a series of selected plasma biochemical parameters, the objective of our study was to predict whether the duck is under severe stress after force-feeding and fast, and whether glucose supply by water can alleviate these effects.

Materials and Methods

110 adult Pekin drakes with similar weight were randomly allotted to 2 groups, with 55 birds each group, one was trial groups and another was control group. Prior to trial, all birds were fasted for 12h, but water were provided *ad libitu*m. And 5 birds from each group were web-bled from their venous in wings. At the same time, each bird of the tow groups was force-fed by pelleted feed 50g, then they were fasted but water was provided *ad libitu*m. 4h later, drakes of the trial group were fed glucose saturated solution for 15 minutes. After that, they were fed glucose saturated solution once every 6h. At 2h, 12h, 24h, 36h, 48h after force-feeding, ten birds from each group were web-bled and discarded, respectively. And venous blood samples were collected from wings of selected birds. Plasma was prepared and frozen at -20°C until biochemical testing was performed.

Plasma contents of glucose, uric acid, total protein, triglyceride were measured by a RA 1000 random access analyzer (Bayer, New York, USA) using reagents from Zhongsheng Inc (Beijing, China). Plasma contents of insulin, triiodothyronine, corticosteroid were measured by a highly specific nonequilibrium RIA (Copeland *et al*., 1980) by a γ-counter from Beijing Medical Instrument Inc (Beijing, China).

Data were analyzed by tow-way analysis of variance using ANOVA procedure of SAS software (SAS Institute, 1996). Means were compared by Duncan's multiple-range test when P-value was statistically significant ($p<0.05$).

Table 1: The Effect of force-feeding on contents of selected biochemical parameters in duck plasma

	Glucose (mmol/l)	Uric Acid (μ mol/l)	Plasma Protein (g/dl)	Triglyceride (mmol/l)	Insulin (mIU/l)	triiodothyronine (nmol/l)	corticosteroid (ng/ml)
B1	7.62±0.16[a]	188±10[a]	3.50±0.15[a]	1.22±0.02[a]	3.87±0.15[a]	4.39±0.16[a]	42.45±1.18[a]
A2	9.65±0.46[b]	179±22[a]	3.16±0.12[a]	1.15±0.07[a]	5.38±0.39[b]	4.88±0.29[b]	44.01±0.89[a]

[a-b]Different superscripts within the treatment and the same parameters indicate significant differences ($p<0.05$).
[1]Before Force-feeding. [2]2-h After Force-feeding.

Table 2: The change of selected biochemical parameters in plasma of ducks during 48-h fast

Fast time (h)	2	12	24	36	48
Glucose (mmol/l)	10.28±1.33[a]	8.23± 0.78[b]	7.54±0.42[b]	8.45± 0.63[b]	8.36±0.90[b]
Uric Acid (μ mol/l)	165±34[a]	194±29[a]	164.5±41[a]	181±29[a]	162.5±40.5[a]
Plasma Protein (g/dl)	3.01±0.37[a]	3.49±0.20[a]	3.20±0.54[a]	3.01±0.29[a]	3.00±0.22[a]
Triglyceride (mmol/l)	1.17±0.27[a]	0.72±0.06[b]	0.53±0.01[bc]	0.51±0.08[c]	0.43±0.05[c]
Insulin (mIU/l)	4.99±1.08[a]	3.88±1.36[abc]	2.32±1.11[c]	2.94±0.98[bc]	4.13±0.36[ab]
Triiodothyronine (nmol/l)	5.16±0.73[a]	0.71±0.17[c]	1.71±0.89[c]	1.36±0.49[c]	3.80±0.81[b]
Corticosteroid (ng/m)	44.94±1.81[a]	39.52±5.49[ab]	41.30±2.76[ab]	44.69±1.82[a]	44.51±1.86[a]

[a-c]Different superscripts within the fast time and the same parameters indicate significant differences ($p<0.05$).

Results

The effect of force-feeding on selected biochemical parameters in plasma of ducks was shown in Table 1. Two hours after force-feeding, the contents of glucose, insulin, triiodothyronine in plasma increased significantly ($p<0.05$), compared with those before force-feeding. Contents of plasma corticosteroid, uric acid, total protein and triglyceride changed non significantly ($p>0.05$).

The effect of fast time on selected biochemical parameters in plasma of ducks were shown in Table 2. The contents of glucose and triglyceride in duck plasma At 2h after force-feeding was significantly higher than at other time point after force-feeding ($p<0.05$). With the increase of fast time, the content of triglyceride in plasma decreased significantly. Fasted for 12h, 24h, 36h and 48h, the contents of glucose, uric acid and total protein in duck plasma didn't change significantly ($p>0.05$), but the contents of insulin and triiodothyronine decreased.

Content of plasma corticosteroid didn't change significantly during the whole fast time.

The effects of glucose supplement to fasted ducks on the change of selected biochemical parameters were shown in Table 3. Glucose supplement had no effect on the contents change of plasma glucose, uric acid and corticosteroid ($p>0.05$). At 12h after force-feeding, the contents change of triglyceride and insulin in plasma were not affected by glucose supplement. Glucose supplement increased the contents of triglyceride and insulin in plasma of the ducks which were fasted for 24h, 36h and 48h ($p<0.05$). The contents of triiodothyronine in plasma of the ducks which were fasted for 12h, 24h and 36h was increased by glucose supplement ($p<0.05$).

Discussion

Brain, nerve centre and red cell must directly get energy from glucose, thus the blood glucose value should be stable. During the 48-h fast, content of glucose in duck plasma fluctuated non significantly, this is in agree with the results of Simon and Rosselin (1978) and Simon *et al.* (1986) who observed similar phenomena in chicks. This is related to an increase in activity of PC and G6Pase which promote degradation of fat and gluconeogenesis during starvation (Shen, 1979; Filsell *et a*l., 1969. Taylor *et al.*, 1978; Swiateck *et al.*, 1970).

When starved, hepatic glycogen of animals was degradated firstly. Fast accelerates the catabolism of hepatic glycogen and depresses anabolism of it, therefore the content of hepatic glycogen decreased significantly (Savenije, 2002). Warris (1988) reported that hepatic glycogen content almost decreased to zero after 6 h fast. With the depletion of glycogen, lipid was catabolized. This trial indicated that with the increase of fast ime, plasma triglyceride content decreased which was in agree with the result of Anthony (1999). Blood triglyceride come from absorption from feed and synthesis in tissues. During starvation, blood triglyceride mainly come from fat tissue.

When triglyceride was catabolized, it released glycerin. Glycerin can be transformed into glucose through gluconeogenesis. But with the prolong of fast time gluconeogenesis couldn't provide enough glucose. To maintain the blood glucose level, body protein catabolism rate increased, and content of plasma uric acid increased. Uric acid content in turkeys plasma fluctuated slightly during the 2-d fast, and it increased when they were fasted more than 2d (Anthony, 1999). In present trial, uric acid and total protein content in duck plasma didn't change significantly during 48h-fast which

Table 3: The effect of glucose supplement on the changes of selected biochemical parameters in the plasma of fast ducks

Fast Time (h)	12		24		36		48	
	Control	Glucose*	Control	Glucose	Control	Glucose	Control	Glucose
Glucose (mmol/l)	8.23±0.78[a]	7.67±0.71[a]	7.54±0.42[a]	7.73±2.98[a]	8.45± 0.63[a]	8.02±0.51[a]	8.36±0.90[a]	8.08±0.68[a]
Uric Acid (μ mol/l)	194±29[a]	175±12[a]	164.5±41[a]	180±14[a]	181±29[a]	173.5±43[a]	162.5±40.5[a]	186±59[a]
Plasma Protein (g/l)	3.49±0.20[b]	2.85±0.34[a]	3.20±0.54[a]	2.81±0.30[a]	3.01±0.29[a]	2.86±0.26[a]	3.00±0.22[a]	3.16±0.22[a]
Triglyceride (mmol/l)	0.72±0.06[a]	0.73±0.14[a]	0.53±0.01[b]	0.80±0.05[a]	0.51±0.08[b]	0.94±0.13[a]	0.43±0.05[b]	0.72±0.29[a]
Insulin (mIU/l)	3.88±1.36[a]	3.82±1.74[a]	2.32±1.11[b]	4.58±1.22[a]	2.94±0.98[b]	4.50±1.28[a]	4.13±0.36[a]	4.64±0.52[a]
Triiodothyronine (nmol/l)	0.71±0.17[b]	3.25±0.15[a]	1.71±0.69[b]	4.46±0.72[a]	1.36±0.49[b]	3.32±0.58[a]	3.80±0.81[a]	4.77±0.96[a]
Corticosteroid (ng/ml)	39.52±5.49[a]	44.78±3.48[a]	41.30±2.76[a]	39.10±3.86[a]	44.69±1.82[a]	39.46±3.72[a]	44.51±1.86[b]	40.29±1.31[a]

[ab]Different superscripts within the treatment and the same parameters indicate significant differences ($p<0.05$). *Glucose supplement. (g/dl)

indicated catabolism rate of body protein didn't increased significantly ($p<0.05$). Therefore, 48-h fast didn't result in any pathology.

Insulin accelerates the synthesis of hepatic glycogen, depresses the degradation of glycogen, enhances the absorption and utilization of glucose by tissues, accelerates the transformation of glucose into lipid, consequently decreases the blood glucose content. Fast resulted in a decrease of plasma insulin, which is in agree with Anthony's (1990) report on turkey. This decrease may promote the degradation of glycogen and lipid for energy supplement. Glucose supplement make a relatively stable insulin level in fast ducks, which indicated that glucose supplement by and large met the energy requirement of fast duck, depressed the degradation of lipid.

The release of triiodothyronine has a rhythm of day and night, which was proved by present experiment. It was indicated that glucose supplement significantly increased the content of triiodothyronine in duck plasma ($p<0.05$). This showed that glucose supplement to fast ducks can alleviate the decrease of maintaining metabolism rate.

Sudden stress, such as the change of environment temperature, anoxia and wound, can result in the significant increase of plasma corticosteroid. In our trial, content of plasma corticosteroid didn't change significantly at 2-h after force-feeding or during the 48-h fast, which indicated that force-feeding and fast didn't result duck in severe stress.

In conclusion, while fasting for 48h or force-feeding, ducks weren't suffered severe physiological stress; water intake containing glucose can alleviate the stress of the birds.

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