CONTENT OF GLYCOGEN IN LIVER AND KETON BODIES IN BLOOD OF MUSCOVY DUCKS DURING STARVING ENVISAGED IN THE METHODS FOR BALANCED EXPERIMENTS

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Manuscript received: February 24, 2005; Reviewed: March 8, 2005; Accepted for publication: June 25, 2005

ABSTRACT

The biochemical indexes "glycogen in liver" and "ketones in blood" of 0-108 hours feed deprived (according to methods for balanced experiments) 22-24 weeks old Muscovy ducklings with and without energy additives were determined.

There were 3 groups of ducks- 1-st without energy supplement, 2-nd- fed with 50 g. glucose per os (as 25% solution) – twice in 24 hours, 3-rd with the same amount of glucose solution, but 3 times/24 hours.

The levels of liver glycogen in all the food-deprived ducks were significantly lower (3930- 9910 mg/kg) compared to the levels of the same index in fed birds (10540 mg/kg tissue). In the birds receiving energy additive they were higher compared to those deprived of the additive throughout the experimental period.

The content of ketones in blood increased in the ducks starving (from 0.0095 to 0.018 mmol/l) and deprived of energy additive as early as the 24th hour, after which they decreased significantly.

The energy additive (30g glucose/24 hours) helped the maintenance of the energy metabolism during continuous food depriving of the experimental ducks. Three-time daily allowance of the additive adapted better the bird organism to starvation.

KEYWORDS: Glycogen, Liver, keto- bodies, Blood, Muscovy ducks

РЕЗЮМЕ

Установени са биохимичните индекси "гликоген в черен дроб" и кетони в кръв" при 0-108 часа лишени от храна 22-24 седмични Мускусни патета (съгласно методика за балансови опити).

Формирани бяха 3 групи от птици – първата без енергийна добавка, на втората се даваше per os по 50 g глюкоза като 25% воден разтвор 2 пъти в денонощие, а на третата – същото количество, но 3 пъти в динонощие.

Нивото на гликоген в черен дроб на всички лишени от храна патета (3930-9910 mg/kg) бе достоверно по – малко от същия показател при хранените птици (10540 mg/kg). При птиците получавали енергийна добавка, то бе по – високо в сравнение с неполучавалите такава за целия опитен период.

Съдържанието на кетотела в кръвта се повишава при гладуване и лишаване от енергийна добавка до 24 час (от 0.0095 до 0.018 mmol/l), след което достоверно намалява.

Енергийната добавка (30 g глюкоза/ 24 часа) спомага за поддържането на енергийния метаболизъм при продължително лишаване от храна на опитните патици. Трикратното разпределение на същата в денонощието адаптира по – добре птичия организъм към гладуването.

КЛЮЧОВИ ДУМИ: Гликоген, черен дроб, кетони, кръв, Мускусни патета

INTRODUCTION

The proper carrying out of balance experiments with birds requires the best possible clearing of the digestive tract from forage residues. That is achieved by food depriving for a certain time, the periods for fowls being in the frames of 48 – 108 hours [16, 1, 13].

The abrupt change of the breeding conditions leads to stress, especially in the high productive bird races [3]. During food depriving the content of glycogen in liver can be reduced almost to zero, while in the muscles usually that does not happen. The energy metabolism is affected during starvation as a result of mobilizing of the body reserves. What is more, the younger the organism is, the more significant the effect of the negative energy balance on metabolism as a whole could be. The maximal compensation of the negative energy balance during induced starvation of birds in accordance with the methods of balance experiments is of great importance because the less the stress of food depriving is, the more significant the results of the balance experiments are. Out of that very reason [9] suggested the 22-24-week old Peking ducks, food-deprived and submitted to balance experiments, to be additionally given per os a certain amount of 30 % solution of glucose, which was practically 100 % absorbed and did not affect the results of digestibility.

During total or partial food depriving the amount of glycogen in liver and muscles decreased significantly due to the intensive disintegration [14].

Ketones are normal metabolites their direct predecessors being mainly fatty acids and partially, the so-called ketogenic amino acids. A very small percentage of them originated from carbohydrates [14]. According to data of different authors [14, 6, 7 etc.] their content in the blood of ruminants was from 0 to 10.9 mg%, and of pigs – 0.5-7.0 mg%. In the available literature we did not find data about their quantity in the blood of ducks.

The aim of the present study was to establish the dynamics of changes in the glycogen in liver and of acetone bodies in the peripheral blood of Muscovy ducks food-deprived for a certain period in accordance with the methods of balance experiments with waterfowls [13].

MATERIAL AND METHODS

In 2004 experiments were carried out with 96 Muscovy ducks at the age of 22-24 weeks, by six in each group. From 6 of them samples were collected for detecting the values of ketones in blood (from v. jugularis for live birds) and from liver post mortem for establishing the glycogen levels. The rest of the fowls formed 3 groups, all of them food deprived (the birds were given drinking water per os during the whole experimental period). The first group was deprived from energy additive for 108 hours. The birds of the second group received by 25 g of pure glucose in 100 ml of water – twice every 12 hour, and, the third group – the same amount but three times every 8 hour per os. Every 24 hour, at least 2 hours after the last energy supply, 6 samples were taken from the periphery blood and 6 – from liver.

The energy additive amount (30 g of pure glucose per 24 hours) was determined according to the data about the necessary net energy for breeding birds (NRC – 1994).

Ketones (in mmol/l of sample) were determined photometrically by modified methods of Natelsson [cited from 2], and, the glycogen in liver (in mg/kg of tissue) – by modified methods of Kaham [8], combined with the test Glucose GOD FS* - Diagnostic Systems – Germany.

Monofactor dispersion analysis was used for comparing the results, the significance of the differences being determined by Student – Fischer [18].

RESULTS AND DISCUSSION

Table 1 presents the dynamics of the glycogen content in duck liver after food depriving from 0 to 108 hours, with and without energy additive.

Glycogen content in the liver of the control birds was 10548.0 mg/kg, the data being compatible with those of 17-24 week young hens [17, 4 etc.] During starvation the glycogen molecule is submitted to rapid enzyme-catalized disintegration, releasing glucose that supplies energy. Due to its intensive disintegration the amount of glycogen in the muscles and especially in liver decreases significantly [15]. It shows that the liver glycogen is easily mobilized at increased energy requirements of the organism [4, 5, 10, 11, 19 etc.].

In the birds deprived of the energy additives the values of the index decreased significantly as early as the 24th hour of starvation. The tendency continued by the end of the experimental period (108 hours) – Fig. 1.

It should be mentioned that the levels of liver glycogen in all the food-deprived ducks were significantly lower than the levels in birds fed.

As for the fowls receiving 30 g of pure glucose twice daily every 12 h, the levels of liver glycogen were significantly higher compared to the birds deprived of glucose until the 72nd hour since the beginning of starvation. After the third day-and-night the values of the index were higher again, however the differences were statistically insignificant.

The fowls receiving the energy additive three times daily, the levels of liver glycogen displayed a tendency to an increase in comparison with the ducks receiving the same amounts of the additive but twice daily.

Table 1. Contents of glycogen in the liver of 20-24 week – old Muscovy ducks (mg in 1000 g)*

Hours after the beginning of the starving	24			48			72			96			108		
Non starved birds	10548.0±36.0; S%= 0.839; Sx%= 0.343 a														
	X	Sx	S%	x	Sx	S%	X	Sx	S%	x	Sx	S%	X	Sx	S%
Starved birds without, glucose addition	4428.0 a, a1, a6	18.0	0.83	3717.1 a, a1, a2, a6	18.0	1.28	4545.0 a, a1, a2, a3, b	27.0	1.657	3888.0 a, a1, a3, a7, nq	36.0	2.278	3681.0 a, a1, a3, a8, nq	27.0	2.375
Starved birds with given of glucose solution – twice in 24 h (30 g glucose in 100 ml water)	9810.0 a, a4, a6, c	126.0	3.04	5850.0 a, a4, a6, c	27.0	0.973	4752.0 a, a4, b	54.0	2.786	3978.0 a, a2, a7, nq	54.0	3.33	3870.0 a, a4, a8, nq	27.0	2.320
Starved birds with given of glucose solution – 3 times in 24 h (30 g glucose in 100 ml water)	9908.0 a1, a5, a6	45.0	0.493	7056.0 a, a5, a6	15.30	5.212	5400.0 a, a5, b	54.0	12.60	4140.0 a, a5, nq	25.2	1.695	3933.0 a, a5, a8, nq	27.0	1.870

* Legend: a-a, a1-a1, a2-a2, a3-a3, a4-a4, a5-a5, a6-a6, a7-a7, a8-a8, significant by p<0.001

b-b - significant by p<0.01; c-c- significant by p<0.05; nq- nq- no significance

Table 2. Content of ketones (acetone) in blood of 20-24 week- old Muscovy ducks (mmol/l)*

Hours after the beginning of the starving	24			48			72			96			108		
Non starved birds	0.0095±0.0007; S%=16.89; Sx%=6.89 a														
	X	Sx	S%	x	Sx	S%	X	Sx	S%	x	Sx	S%	x	Sx	S%
Starved birds without, glucose addition	0.018 a, a1, a2, b, c1	0.0007	10.58	0.013 c1	0.00012	23.37	0.011 c1	0.0009	17.40	0.0115 b	0.0003	8.65	0.0125 c, b	0.0007	15.03
Starved birds with given of glucose solution – twice in 24 h (30 g glucose in 100 ml water)	0.010 c2, a1	0.0009	19.69	0.015 c2	0.0028	49.79	0.0093 c2	0.0005	13.59	0.012 c2	0.00034	7.78	0.013 c, c2	0.0001	20.07
Starved birds with given of glucose solution – 3 times in 24 h (30 g glucose in 100 ml water)	0.008 a2	0.0009	27.86	0.013	0.0026	47.99	0.008	0.002	50.86	0.005	0.0009	41.59	0.009	0.001	28.05

* Legend: a-a, a1-a1, a2-a2, - significant by p<0.001

b-b - significant by p<0.01; c-c, c1-c1, c2-c2- significant by p<0.05

Despite the rate frequency of the energy additive, the liver glycogen values were significant higher compared to the same, for the starved and not received energy additive birds.

Table 2 presents the dynamics of the ketones content in the blood of the experimental birds.

The mean content of ketones in the blood of fed birds was 0.0095 mmol/l, the data being the closest to those of pigs cited by [7, 6 etc]. In the available literature we did not find data about the levels of that index for ducks.

In the fowls deprived of the energy additive, the values of the ketones were higher compared to the control. Those levels were the highest at the 24th hour of starvation, after which they manifested a tendency of slightly decreased but comparatively stable values, remaining higher than in the fed analogues – Fig. 2.

It should be underlined that in the birds receiving the energy additive three times daily the ketones in blood were significantly lower in comparison with those receiving the additive twice. In the birds deprived of the energy additive, their peak increase was observed as early as the 24th hour of starvation, and, later, the values decreased to comparatively stable levels. It could be concluded that the receiving of one and the same amount of energy additive 3 times/24 hours decreased the amount of ketones in blood which is a result for the better energy supply of the cells.

The acetone (ketones) are organic compounds that include: 1. Acetone; 2. Acetoacetic acid; 3. β – oxyfatty

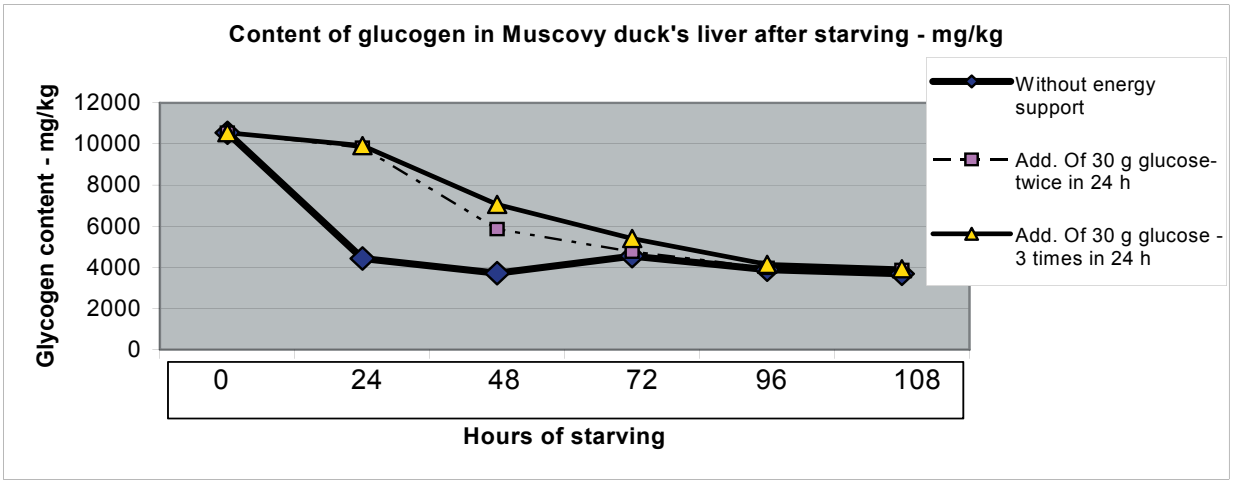

Fig. 1. Comparative data from the glycogen – content in the liver of 20-24 week- old Muscovy ducks

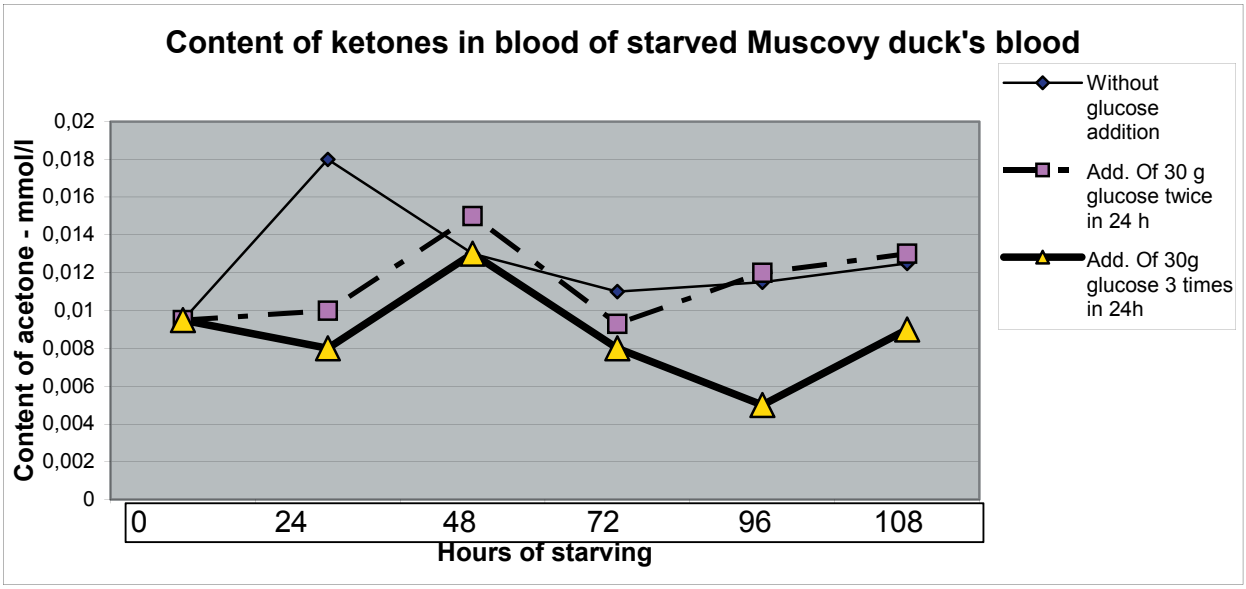

Fig. 2. Comparative data from the ketones – content in the blood of 20-24 week- old Muscovy ducks (mmol/l)

acid. As normal metabolites they are to be found in small quantities in the blood of the domestic animals: cattle- 3-8 mg%, sheep – 3-7 mg% and pigs – 0.5-2.5 mg% [7, 6] and, in human blood they are below 30 mg/l [14]. Data of our experiments were close to those in pigs.

CONCLUSIONS

The levels of liver glycogen in all the food-deprived ducks were significantly lower compared to the levels of the same index in fed birds. In the birds receiving energy additive they were higher compared to those deprived of the additive throughout the experimental period.

The content of ketonic bodies in blood increased in the ducks starving and deprived of energy additive as early as the 24th hour, after which they decreased significantly.

The energy additive (30 g of glucose/24 hours) helped the maintenance of the energy metabolism during continuous food depriving of the experimental ducks. Three-time daily allowance of the additive adapted better the bird organism to starvation.

ACKNOWLEDGEMENT

The experiments were conducted with the financial support of project 23U – Research Centre at the Agricultural University – Plovdiv.

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