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# BLOOD CHEMISTRY CHANGES IN BROILER CHICKENS FOLLOWING SUPPLEMENTATION WITH *CINNAMOMUM ZEYLANICUM**

## *BIOHEMIJSKE PROMENE U KRVI BROJLERA POSLE DODAVANJA CINNAMOMUM ZEYLANICUM U HRANU*

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*A study was conducted to investigate the effects of different doses of Cinnamomum zeylanicum in diet on blood biochemistry of broiler chickens. Thirty two, 1-d old male broiler chickens of a commercial strain ROSS 308 were distributed into groups of 8 birds in each one. The chicks received the diets from the day of hatching to 38 d of age. The four types of diets included basal diets for chicks (HYD 01, HYD 02 and HYD 03) supplemented by 0%, 0.1%, 0.05 and 0.025% cinnamon (Cinnamomi aetheroleum of Cinnamomum zeylanicum, Calendula a.s., Nová L'ubovňa, Slovakia). Continuous lighting and water and feed ad libitum were provided throughout the trial. The addition of cinnamon to the diets caused a significantly lower plasma glucose level and the effects of cinnamon on plasma glucose levels tended to be dose-dependent. Dietary intake of 0.05 and 0.025% cinnamon reduced serum ALT and plasma potassium levels. Ingestion of cinnamon, however, resulted in no significant changes in circulating calcium, albumin, triglycerides, free glycerol and cholesterol levels. It was concluded that cinnamon could be used not only for flavor and taste in food preparation but it had an additional role in glucose metabolism in broiler chickens.*

*Key words: blood chemistry, broiler chicks, cinnamon*

## Introduction / *Uvod*

The use of antibiotics as growth promoters in animal feeds is facing declining social acceptance due to the appearance of residues and resistant

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strains of bacteria (Gustafson and Bowen, 1997); antibiotic use has been banned in the European Union since January 2006 (Regulation 1831/2003/EC).

Many herbs and plant extracts have antimicrobial activities and antioxidant properties which make them useful as natural additives in animal feeds. Si *et al.* (2006) reported that cinnamon exerts antimicrobial activity against *Salmonella* serotype *Typhimurium* DT 104 of swine *in vitro* study. These findings are in agreement with reports of Prabuseenivasan *et al.* (2006). They reported that cinnamon clove, geranium, lemon, orange and rosemary oils exhibited a significant antibacterial effect against both gram-negative and gram-positive bacteria *in vitro.* The antioxidant effect of aromatic plants is due to the presence of hydroxyl groups in their phenolic compounds (Shahidi *et al.,* 1992).

Most essential oils are classified as Generally Recognized as Safe (GRAS), and have been approved for food and beverage consumption by the US Food and Drug Administration.

Plant extracts (anise oil, cinnamon oil, garlic oil) may allow the manipulation of rumen microbial fermentation by decreasing total volatile fatty acid concentration and reducting ammonia N concentration (Busquet *et al.,* 2006). Essential oils derived from sage, rosemary, thyme and other herbs inhibit osteoclast activity and *in vitro* leading to an increase in bone density (Putnam *et al.,* 2006).

Recently, it was reported that some essential oils such as cinnamon have the potential to favorably influence the insulin system and beneficial effects on blood glucose and lipid metabolism of people with type 2 diabetes (Khan *et al.,* 2003).

There is a dearth of literature regarding the effects of cinnamon on blood biochemistry of broiler chickens.

The objectives of the current study were, therefore, to investigate the effects of different doses of *Cinnamomum zeylanicum* in diet on blood biochemistry of broiler chickens.

## Materials and methods / *Materijal i metode rada*

*Animals and diets*

Thirty two 1-d old male broiler chicks of a commercial strain (ROSS 308, Párovské háje, Slovakia) were randomly distributed into groups of 8 birds in each one. The birds were kept on the floor for the course of the study. Chicks were initially kept at 31 °C; then the temperature was gradually lowered to a final temperature of 28 °C. Continuous lighting and water and feed *ad libitum* were provided throughout the experiment.

All experimental procedures with animals were in accordance with European Guidelines for Care and Use of Animals for Research Purpose and they were approved by a local ethic committee.

The chicks received the diets from the day of hatching to 38 d of age. The basal diets were formulated to meet or exceed all nutritional requirements of starter, grower and finisher (Table 1). The four types of diets included basal diets for chicks (HYD 01, HYD 02 and HYD 03) supplemented by 0%, 0.1%, 0.05% and

0.025% cinnamon (Cinnamomi aetheroleum of *Cinnamomum zeylanicum*, Calendula a.s., Nová L'ubovňa, Slovakia), certificate of quality No 610.

Table 1. *Composition of diets ( %)*
*Tabela 1. Sastav hrane*

| Ingredient | Growing period | | |
|---|---|---|---|
| | 0-18 days (starter) HYD -01 | 19-31 days (grower) HYD-02 | 32-38 days (finisher) HYD-03 |
| Wheat ground / *Pšenične mekinje* | 34.84 | 30.0 | 30.0 |
| Maize ground / *Kukuruzne mekinje* | 35.0 | 41.4 | 43.0 |
| Soybean extracted ground meal *Ekstrahovano sojino brašno* | 21.0 | 22.0 | 21.60 |
| Fish meal / *Riblje brašno* | 5.0 | 2.0 | 0.90 |
| Calcium carbonate / *Kalcijum karbonat* | 1.0 | 1.0 | 1.10 |
| MCP | 0.80 | 0.70 | 0.90 |
| Natrium chloride / *Natrijum hlorid* | 0.32 | 0.35 | 0.35 |
| Lysine / *Lizin* | 0.18 | 0.22 | 0.25 |
| Methionine / *Metionin* | 0.25 | 0.25 | 0.24 |
| Threonine / *Treonin* | 0.05 | 0.05 | 0.05 |
| Cycostat 6.6% | 0.05 | - | - |
| Bergafat 306 | 1.0 | 1.47 | 2.0 |
| KWD | 0.01 | 0.01 | 0.01 |
| Sacox 12% | - | 0.05 | - |
| Euromix Hyd 01, 02, 03 | 0.5 | 0.5 | 0.5 |
| | Calculated analysis | | |
| Metabolic energy (MJ) / *Energetski metabolizam* | 12.09 | 12.24 | 12.34 |
| Total nitrogen (g) / *Ukupni azot* | 208.9 | 191.67 | 176.86 |
| Lysine (g) / *Lizin* | 11.94 | 10.93 | 10.02 |
| Methionine (g) / *Metionin* | 6.05 | 5.55 | 5.06 |
| Linoleic acid (g) / *Linoleinska kiselina* | 12.75 | 13.69 | 13.99 |
| Phosphorus (g) / *Fosfor* | 5.41 | 4.22 | 3.75 |
| Calcium (g) / *Kalcijum* | 8.24 | 7.20 | 7.30 |

MCP – monocalcium phosphate (227 g P/kg MCP, 160 g Ca/kg MCP), cycostat 6.6% - coccidiostaticum, Bergafat 306 – energy substances on fat base, KWD – multienzymatic preparation, Sasox 12% (Natrium salinomycinate), Euromix Hyd 01, 02, 03 – mixture of vitamins and minerals. /
*MCP– monokalcijum fosfat (227 g P/kg MCP , 160 g Ca/kg MCP), cycostat 6.6% - kokcidiostatik, Bergafat 306– energetska supstanca na bazi masti, KWD– multienzimski preparat, Sasox 12% (Natrium salinomycinate), Euromix Hyd 01, 02, 03 – mešavina vitamina i minerala*

*Sampling and analyses*

At the age of 38 days, chickens from each group were anaesthetized with intraperitoneal injection of xylazine (Rometar 2%, SPOFA, Czech Republic) and ketamine (Narkamon 5%, Czech Republic) at doses 0.6 and 0.7 ml.kg$^{-1}$ of body weight, respectively. After laparotomy, blood was collected into heparinized tubes by intracardial punction and centrifuged for plasma specimens at 1180 g for 10 min. Samples of plasma for analysis were frozen and stored at -65 $^{o}$C. Serum was stored at +2 to +8$^{o}$C.

*Chemicals*

Kits for calcium, potassium, alkaline phosphatase (ALP) and glucose assays were obtained from BIO-LA-test (Pliva-Lachema Brno, Czech Republic). Kits for glutamate dehydrogenase (GOH), aspartate aminotransferase (AST), alanine aminotransferase (ALT), albumin, triglycerides, cholesterol and free glycerol assays were purchased from RANDOX Lab. (Crumlin, United Kingdom).

*Statistical analysis*

Results are presented as mean ± S.E.M. Statistical significance was performed by a one-way analysis of variance (ANOVA).

## Results / *Rezultati*

Addition of cinnamon to the diets caused a significantly lower plasma glucose level and the effects of cinnamon on plasma glucose levels tended to be dose-dependent (Table 2).

Table 2. *Effect of 38 day administration of Cinnamomum zeylanicum oil by diet on biochemical indices in broiler chickens*
*Tabela 2. Efekat primene Cinnamomum zeylanicum u ishrani brojlera do 38 dana na biohemijske rezultate*

| Indices / *Pokazatelji* | Diets / *Ishrana* | | | |
|---|---|---|---|---|
| | Control group / *Kontrolna grupa* | 0.1% cinnamon / *0,1% cimet* | 0.05% cinnamon / *0,05% cimet* | 0.025% cinnamon / *0,025% cimet* |
| Calcium / *Kalcijum* (mmol/l) | 1.53± 0.11 | 1.80± 0.17 | 1.70±0.14 | 1.60±0.12 |
| Potassium / *Kalijum* (mmol/l) | 6.74± 0.37$^{b}$ | 6.55±0.66$^{cd}$ | 4.12±0.34$^{abc}$ | 6.04±0.30$^{ad}$ |
| ALT (µkat/l) | 1.53±0.09$^{ab}$ | 1.25±0.01 | 0.88±0.21$^{a}$ | 0.95±0.09$^{b}$ |
| AST (µkat/l) | 2.80±0.28 | 2.84±0.20 | 2.60±0.30 | 2.61±0.15 |
| ALP (µkat/l) | 7.32±0.37 | 7.59±0.04 | 7.78±0.67 | 7.56±0.53 |
| GDH (µkat/l) | 0.20±0.03 | 0.16±0.01 | 0.17±0.02 | 0.18±0.02 |
| Glucose / *Glukoza* (mmol/l) | 14.80±0.55$^{ab}$ | 8.79±0.35$^{acd}$ | 11.79±0.63$^{bc}$ | 12.45±0.74$^{d}$ |

| Cont. Table 2 / *nastavak tabele 2* | | | | |
|---|---|---|---|---|
| Albumin / *Alubumin* (g/l) | 12.10±0.30 | 12.12±0.26 | 12.05±0.27 | 12.45±0.23 |
| Triglycerides / *Trigliceridi* (mmol/l) | 0.55±0.03 | 0.51±0.01 | 0.52±0.03 | 0.48±0.03 |
| Free glycerol / *Slobodni glicerol* (mmol/l) | 0.46±0.02 | 0.43±0.01 | 0.43±0.02 | 0.39±0.02 |
| Cholesterol / *Holesterol* (mmol/l) | 3.16±0.17 | 3.29±0.19 | 2.90±0.19 | 3.21±0.21 |

Significant differences within a row are indicated by the same superscript letter, $P<0.05$; mean ± S.E.M., n = 8. / *Značajne razlike unutar redova su indikativne za vrednosti veće od P<0,05*

Dietary intake of 0.05% and 0.025% cinnamon reduced serum alanine aminotransferase activity and plasma potassium levels. Ingestion of cinnamon resulted in no significant changes in circulating calcium, albumin, triglycerides, free glycerol and cholesterol levels (Tables 1).

## Discussion / *Diskusija*

Dietary addition of cinnamon (0.1, 0.05 and 0.025%) to broiler chickens for 38 days resulted in a decreased plasma glucose level in a dose-dependent manner.

*C. zeylanicum* has been shown to be generally safe when ingested and to have many pharmacological properties, such as antioxidant activity, anti-inflammatory and antimicrobial effects (Mancini-Filho *et al.,* 1998; Lopez *et al.,* 2005).

Methylhydroxychalcone polymer (MHCP) in *C. zeylanicum* was found to be an effective mimetic of insulin (Jarvill-Taylor *et al.,* 2001). MHCP demonstrated *in vitro* activation of glycogen synthase and inhibition of glycogen synthase kinase- 3β as well as insulin receptor phosphorylation homologous to the effects of insulin in 3T3-L1 adipocytes. Later it was found that cinnamaldehyde in *C. zeylanicum* was effective in decreasing plasma glucose concentration, glycosylated hemoglobin, serum total cholesterol, triglyceride level and in addition markedly increased plasma insulin, hepatic glycogen and HDL cholesterol level to streptozotocin-induced male diabetic Wistar rats (Subash Babu *et al.,* 2007).

Effect of *C. zeylanicum* on blood glucose and insulin sensitivity was evaluated in several animal studies.

Kannappan *et al.* (2006) reported that dietary cinnamon extract improved glucose tolerance and prevented the hyperlipidemia observed in fructose-fed rats. Similar results were observed in db/db mice. Kim *et al.* (2006) suggested that dietary cinnamon extract had a regulatory role in blood glucose levels and lipids and it could also exert a blood glucose suppressing effect by improving insulin

sensitivity or slowing absorption of carbohydrates in the small intestine. Similarly Talpur *et al.* (2005) observed that combinations of essential oils such as fenugreek, cinnamon, cumin, oregano lowered circulatory glucose levels and systolic blood pressure in both Zucker fatty rats and spontaneously hypertensive rats, suggesting that these natural products are enhancing insulin sensitivity.

On the other hand, Sambaiah and Srinivasa (1991) reported that common spices – cumin, cinnamon, ginger, mustard and tamarind added to normal and hypercholesterolemia-inducing diet did not show any cholesterol lowering effect when added in the diet of the rat at about 5-fold the normal human intake.

Cinnamon has been investigated in human studies for its antidiabetic properties.

For instance Khan *et al.* (2003) demonstrated that intake of 1, 3, or 6 g of cinnamon *per day* significantly reduced serum glucose, triglyceride, LDL cholesterol and total cholesterol in people with type 2 diabetes suggesting that the inclusion of cinnamon in the diet of people with type 2 diabetes could reduce risk factors associated with diabetes and cardiovascular diseases.

Though the Mang *et al.* (2006) trial also observed a significant decrease in fasting glucose, the magnitude of the effect was far less dramatic; no significant change was observed in lipid profile markers or in HbA1c after cinnamon intake. Recently Wang *et al.* (2007) reported significant reductions in insulin resistance in women with polycystic ovary syndrome treated orally by cinnamon.

On the other hand, Vanschoonbeek *et al.* (2006) did not observe a significant change in blood sugar or lipid profile markers. Similar results were observed by Suppapitiporn *et al.* (2006). They demonstrated that cinnamon powder 1.5 g /d did not have any significant effect in reducing fasting plasma glucose, HbA1c and serum lipid profile in type 2 diabetic patients.

In the present study lipid profile parameters, calcium and albumin were unaffected by cinnamon intake by broiler chickens.

The discrepancy between our data and results of other animal experiments could be due to a number of factors, including differences in the effect of cinnamon between species, cinnamon concentration, cinnamon source (quality and chemical characterization), animal genetics or sex.

No adverse effect of cinnamon in doses used in animals was recorded.

This prelimitary study about effects of different doses of *Cinnamomum zeylanicum* on blood biochemistry showed that 38 d administration of cinnamon caused a significantly lower plasma glucose level by broiler chickens.

## Conclusion / *Zaključak*

The presence of cinnamon in the diet decreased the levels of blood glucose and its effect on blood glucose tended to be dose-dependent. Cinnamon in the used doses had no adverse effect on the metabolism of chicks.

It was concluded that cinnamon could be used not only for flavor and taste in food preparation but it had an additional role in the glucose metabolism of broiler chickens.

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## SRPSKI

### BIOHEMIJSKE PROMENE U KRVI BROJLERA POSLE DODAVANJA *CINNAMOMUM ZEYLANICUM* U HRANU

Sprovedena su istraživanja da bi se ustanovili efekti različitih doza *Cinnamomum zeylanicum* dodatih u hranu na biohemiju krvi kod brojlera. Trideset dva jednodnevna brojlera komercijalnog soja ROSS 308 su podeljeni u grupe od po 8 pilića u svakoj grupi. Pilići su dobijali odredjenu ishranu od dana izleganja do 38 dana starosti. Četiri vrste dijete su uključivale osnovnu dijetu za piliće (HYD 01, HYD 02 i HYD 03) sa dodatkom 0%, 0,1%, 0,05% i 0,025% cimeta (*Cinnamomi aetheroleum* iz *Cinnamomum zeylanicum, Calendula* a.s., Nova Lubovna, Slovačka). Tokom celog eksperimenta obezbedjeni su svetlost i voda i hrana *ad libitum*. Dodavanje cimeta ishrani izazvalo je značajno niže nivoe glukoze u plazmi i čini se da su efekti cimeta na nivoe glukoze u plazmi bili u zavisnosti od doze. Unos 0,05% i 0,025% cimeta kroz ishranu smanjilo je nivoe ALT u serumu i kalijuma u plazmi. Međutim, unos cimeta nije rezultirao u značajnim promenama u nivoima kalcijuma, albumina, triglicerida, slobodnog glicerola i holesterola u cirkulaciji. Zaključeno je da bi se cimet mogao koristiti ne samo radi davanja mirisa i ukusa hrani, već i zbog njegove dodatne uloge u metabolizmu glukoze kod brojlera.

Ključne reči: biohemija krvi, brojleri, cimet

## РУССКИЙ

### ИЗМЕНЕНИЯ В КРОВЯНОЙ ХИМИИ У БРОЙЛЕРОВ ПОСЛЕ ДОБАВЛЕНИЯ *CINNAMOMUM ZEYLANICUM* В КОРМ

**Zita Faixova**

Проведены исследования, чтобы установились эффекты различных доз *Cinnamomum zeylanicum* в кормлении на биохимию крови у бройлер цыплят. Тридцать два однодневных самца бройлера коммерческого штамма РОСС 308

разделены в группы от по 8 цыплят в каждой группе. Цыплята получали определённое кормление от дня вывеения до 38 дней старости. Четыре вида диеты включали основную диету для цыплят (ХИД 01, ХИД 02 и ХИД 03) с добавкой 0%, 0,1%, 0,05% и 0,025% корицы (*Cinnamomi aetheroleum* из *Cinnamomum zeylanicum, Calendula* a.s., Nova Lubovna, Словакия). В течение целого эксперимента обеспечены свет и вода и корм ад либитум - как угодно. Добавление корицы кормлению вызвало значительное более низкие уровни глюкозы в плазме и кажется, что эффекты корицы на уровни глюкозы в плазме были в зависимости от дозы. Прибыль 0,05% и 0,025% корицы через кормление уменьшил уровни АЛТ в серуме икалия в плазме. Между тем, прибыль корицы не являлся результатом в значительных изменениях в уровнях кальция, альбуминов, триглицеридов, свободного глицерола и холестерина в циркуляции. Сделан вывод, чтобы корица могла пользоваться не только ради давания запаха и вкуса корму, уже и из-за его дополнительной роли в метаболизме глюкозы у бройлеров.

Ключевые слова: химия крови, бройлер цыплята, корица