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Influence of Citrosept addition to drinking water and *Scutellaria baicalensis* root extract on the content of selected mineral elements in blood plasma of turkey hens

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Abstract

The aim of this study was to investigate the influence of Citrosept preparation and *Scutellaria baicalensis* root extract, administered *per os* to growing turkey hens in 3 different dosages, on the content of selected mineral elements in blood plasma of slaughter turkey hens. An attempt was also made to specify the most effective dosage of the applied preparations with the highest efficiency regarding increased levels of examined macro- and microelements in the birds' blood. The research experiment was conducted on 315 turkey hens randomly divided into seven groups, each consisting of 45 turkey hens. Group C constituted the control group without experimental additions of the above-mentioned preparations. In turkey hens in groups II–IV, Citrosept preparation was instilled to water in the following dosages: Group II – 0.011 ml/kg of bm; Group III – 0.021 ml/kg of bm; Group IV – 0.042 ml/kg bm. For birds which belonged to groups V–VII, a preparation of *Scutellaria baicalensis* root extract was instilled to water in the following dosages: Group V – 0.009 ml/kg of bm; Group VI – 0.018 ml/kg of bm, Group VII – 0.036 ml/kg bm. In the examined plant extracts and blood plasma of the birds the levels of Na, K, Ca, Mg, Cu, Zn, and Fe were identified. The use of examined extracts influenced changes in the levels of all tested elements in slaughter turkey hens' blood plasma. An upward tendency was recorded in the level of calcium and magnesium, and a downward tendency of sodium, potassium, copper, zinc, and iron in relation to the results achieved in the control group.

Key words

Citrosept, *Scutellaria baicalensis* root extract, mineral elements, blood, slaughter turkey hens

INTRODUCTION

The use of phitobiotics in animal production increased when AGS (antibiotic growth stimulators) were withdrawn and the consumer demand for so-called healthy food increased. The use of adequately selected, when it comes to botanical content, herbal resources in animal feeding has become the subject of numerous research studies. The scope of effects of herbs and herbal preparations made from the resources will be related to the type of active substances which dominate in preparations and their activeness which, in turn, is closely connected to the species of plant which constitutes the herbal resource [1, 2, 3, 4]. The active substances contained in Citrosept and *Scutellaria baicalensis* root extract (*inter alia*, flavonoids, o-dihydroxy phenols, tannins) have a strictly defined influence on the animal organism. Citrosept, which is obtained from seeds, pulp and white membranes of grapefruit, is used preventively as a diet supplement rich in flavonoids with diversified biological activeness, which are wide-spread in the world of plants. Grapefruit extract is capable of fighting or suppressing the growth of a number of pathogenic bacteria, fungi, viruses and unicellular parasites. Flavonoid compounds increase absorption of vitamins, strengthen immunity and physical fitness. They prevent sclerosis, cardiac infarctions, and embolism of blood vessels through the process of sealing their walls, which influences their smoothness and elasticity, which prevents the aggregation of blood platelets and cholesterol plate deposition on their surface. Flavonoid compounds are used in the case of reduced immunity, after antibiotic therapy, periods of flu epidemics, or colds [2, 5].

Scutellaria baicalensis is a plant which is not very well-known in Poland, but it grows well in our climate. The root of this plant is widely used in China and Japan. This plant is rich in flavonoids which act as a modifier of inflammatory processes and thus protects the organism against bacterial infections. Their presence in the plant causes that *Scutellaria baicalensis* has antiviral, antineoplasm, and antioxidising properties [6, 7, 8, 9].

Tested, natural pharmaceutical preparations made of such plants are also a conglomerate of vital bioelements such as: Na, K, Mg, Ca, Cu, Zn and Fe. Due to this fact, they also influence the correct and beneficial balance of mineral elements in a food dosage for animals. Thanks to the use of these preparations

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we can influence the proper course of physiological, catalytic, and regulatory functions of an animal organism. Macro- and microelements are an important building part of the turkey's body and decide about the well-being and productivity of these birds. The metabolic efficiency depends on the amount of absorbed mineral elements from the alimentary tract and their usage in biochemical transformations at the cellular and tissue levels [10].

Objective. The aim of the research was to investigate the influence of Ca itrosept preparation and *Scutellaria baicalensis* root extract, administered *per os* to growing turkey hens in 3 different dosages, on the level of selected mineral elements in blood plasma of slaughter turkey hens. An attempt was also made to specify the most effective dosage of the applied preparations with the highest efficiency regarding increased levels of examined macro- and microelements in the birds' blood.

MATERIALS AND METHOD

Experiment scheme. The research experiment was conducted on 315 turkey hens randomly divided into 7 groups, each consisting of 45 turkey hens. Within the groups, a random division into 3 replication subgroups, each consisting of 15 birds was applied. Rearing of the turkeys was carried out according to zootechnical assumptions for this species and breed of birds. The birds were kept from the beginning of the 6th week to the end of the 15th week of life in a pen, in a room with a floor raising system. Group C constituted the control group without experimental additions of the above-mentioned preparations. For the turkey hens which belonged to groups II–IV, the Citrosept preparation was instilled to water in the following dosages: Group II – 0.011 ml/kg of bm; Group III – 0.021 ml/kg of bm; Group IV – 0.042 ml/kg bm. For birds which belonged to groups V–VII, a preparation of *Scutellaria baicalensis* root extract was instilled to water in the following dosages: Group V – 0.009 ml/kg of bm; Group VI – 0.018 ml/kg of bm, Group VII – 0.036 ml/kg bm. While the experiment was being conducted, the turkey hens from all groups were given *ad libitum* standard granular all-mash feed made by Animex, adjusted to the age and developmental stage of birds, according to a programme which consisted of 5 feeding sub-periods. The content of basic nutrients in feeds corresponded to the current recommendations of Poultry Feeding Norms [11].

The examined additions of the above-mentioned preparations were administered to drinking water through the period of 28 days (6–9 week of life). After 4 weeks of preparations' application, a 2-week break was introduced in the supplementation (10–11 week of life), during which the turkey hens were given pure water without additions of the examined preparations. The introduction of the 2-week break was due to the rules for the application of natural immunostimulating substances, as it was ascertained that better results are achieved for a discontinuous than continuous therapy. Excessive application time of immunostimulating preparations, as stated by Grela et al. [12], in the research results may cause immunosuppression in animals. After the 2-week break, the turkey hens were again given the same additions of plant preparations to water, with identical dosages as at the beginning of the experiment (12–15 week of life). At the end of the 9th, 11th and 15th week of life (18 turkey hens from each group) blood from *vena basilica* was taken for tests. The blood was taken in the morning hours after 2-hour starvation of birds. The blood samples were cooled in a portable fridge and underwent analysis within 4 hours.

Plant preparations were instilled into drinking water from the 36th day of life, bearing in mind the critical period in their rearing related to wattles; this period requires special feeding and care. Turkey hens in this period are more vulnerable to colds, respiratory system diseases and alimentary system diseases. In this period, turkey hens willingly eat bitter plants, such as yarrow and gentian, which irritate the mucous membrane and cause increased secretion of digestive juices, which in turn, increase hunger and lower the pH of gastric contents.

The rationale behind the application of grapefruit and *Scutellaria baicalensis* root extracts was the high content of plant substances with similar properties, i.e. flavonoids, o-dihydroxy phenols, tannins or glycosides in their resources.

Scope of the analysis. The sum of flavonoids content after calculation into quercetin in plant extracts was determined with the use of spectrometry UV–VIS [13], measuring after 45 minutes the extinction of the tested solution with aluminium chloride, against the zero sample (acetate extract + mixture of acetic acid with methanol), at the wave length λ=425 nm. The concentration of flavonoid compounds was calculated taking into account the content of flavonoids in the samples read from the analytical curve and the coefficient which indicated dilution of the analysed samples.

The content of o-dihydroxy phenols after calculation into caffeic acid ($C_9H_7O_4$) was determined with the use of spectrometry with Folin reagent [14]. The extinction of solutions was measured against the zero sample (methanol + Folin reagent + calcium carbonate), at the wave length λ=750 nm. The results were read from the standard curve drawn for proper concentrations of caffeic acid and presented in mg/ml of the extract.

The designation of tannins in plant extracts was conducted with the use of a weight-titration method, in which the ability to create sediments which are difficult to dissolve in the reaction of tannins with Cu^{2+} ions [15] is used. A two-phase designation was carried out. In the first phase tannins were precipitated with the use of copper (II) acetate. The precipitated tannin sediment was drained-off, dried, and its mass determined. In the second phase, the excess of Cu^{2+} ions not bonded by tannins was titrationed with the use of 0.1 M of sodium thiosulfate. The content of the analyte in the sample was calculated by subtracting the copper molar mass of the excess not bonded by tannins from the copper molar mass, which was added (in the form of copper acetate solution with a known concentration) to the analyte solution before titrationing the excess of the titrant. The results related to the content of tannins in the tested plant preparations are given in weight %.

In the blood plasma the content of selected macroelements (Na, K, Ca, and Mg) and microelements (Cu, Zn, and Fe) was determined. Designation of the above-mentioned elements (except for Fe), was carried out with the use of spectrometry, with specialist reagents produced by Cormey company. The content of iron after the 4th and 40th attenuation of the plasma with deionised water was determined in the Central Agroecological Laboratory (CAL) applying atomic absorption spectrometry with atomisation in flame (FAAS). Designation was conducted in UNICAM SOLAR 939 spectrometer using an oxy-fuel torch [16].

Phytochemical analysis included designation of the content of selected mineral elements (as in blood plasma) in the tested preparations and the content of vitamin C. Tillmans titration method was used to determine the content of vitamin C in preparations, according to the Polish norm [17]. The tested samples in the form of plant extracts underwent titration with 2,6-dichlorophenolindophenol. This dye oxidised ascorbic acid to dehydroascorbic acid, and reduced to a colourless lecocompound. The calculations were made on the basis of designations of the analytical solution of L-ascorbic acid with concentration 1 mg·cm^{-3}.

Statistical analysis. The achieved results were analysed statistically with the use of a one-way analysis of variance. The significance of differences between groups was designated with the use of Duncan *post-hoc* test and computer software Statistica 6.0 PL, assuming the level of significance $p \leq 0.05$ and $p \leq 0.01$.

RESULTS AND DISCUSSION

The content of mineral elements and vitamin C in Citrosept, as well as the *Scutellaria baicalensis* root extract, is presented in Table 1. The results indicate a differentiated mineral composition and content of ascorbic acid in the tested extracts. The high influence on different content of elements might have been caused by differentiated composition of the analysed plant extract, as well as factors affecting plants, from which the resources for producing extracts were achieved before and after the collection of plants. The high content of vitamin C in Citrosept is obvious, because it was added in a synthetic form as one of the extract's components. In *Scutellaria baicalensis* root extract, trace amounts of this compound were detected.

Table 1. Content of mineral elements and vitamin C in Citrosept preparation and in *Scutellaria baicalensis* root extract

Pharma-ceutical preparation	Macro-elements				Micro-elements			Vitamin C mg·ml^{-1}
	Na mg·l^{-1}	K mg·l^{-1}	Ca mg·l^{-1}	Mg mg·l^{-1}	Cu mg·l^{-1}	Zn mg·l^{-1}	Fe mg·l^{-1}	
Citrosept	3.86	1.432	40.63	4.96	0.048	1.272	0.204	1000
Scutellaria baicalensis extract	0.836	4.871	0.952	0.533	0.028	0.007	0.018	*

Citrosept was characterised by a significantly higher content of all mineral elements, compared to *Scutellaria baicalensis* root extract, with the exception of potassium, which occurred in considerably lower amounts. In *Scutellaria baicalensis* root extract, the content of potassium was 3 times higher (4.871 mg·l^{-1}) as compared to Citrosept (1.432 mg·l^{-1}). According to Lityński and Jurkowska [18], the content of potassium in plants can fluctuate from 0.3% – 8% K_2O and depends mainly on the amounts of the element which can be assimilated from soil, the presence of other cations in the ground, and the species of a plant. The concentration of this element is diverse in particular parts of a plant, moreover, it changes with the period of vegetation.

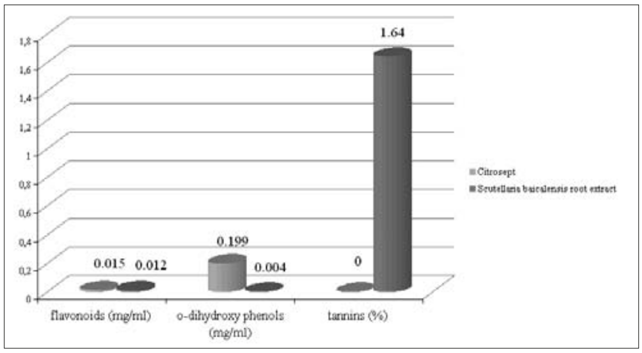

Figure 1. Content of biologically-active substances in Citrosept preparation and *Scutellaria baicalensis* root extract used in the experiment

Figure 1 presents the content of designated active biological compounds (flavonoids, o-dihydroxy phenols, and tannins), in extracts from grapefruit and *Scutellaria baicalensis* root.

The results proved the presence of flavonoids, which were at a level similar to the Citrosept preparation (0.015 mg·ml^{-1}) and *Scutellaria baicalensis* root extract (0.012 mg·ml^{-1}). High differences between preparations were seen in the presence of phenol acids (o-dihydroxy phenols). In Citrosept, these compounds were found at the level of (0.199 mg·ml^{-1}), whereas in *Scutellaria baicalensis* root extract trace amounts of these compounds were found (0.004 mg·ml^{-1}).

Research by Rice-Evans [19] on the repression of tyrosine nitration by nitrate (III) peroxides proved that dihydroxy derivatives, among others, caffeic acid, indicate a higher antioxidising activity than monohydroxy derivatives (p-coumaric acid, ferulic acid). The much higher content of these compounds in Citrosept may result from the additional presence of a strong antioxidant in the form of vitamin C in the preparation.

In turn, the content of derivatives phenolic acids (tannins) in *Scutellaria baicalensis* root extract was at the level of 1.64%, while in grapefruit extract the presence of the above-mentioned chemical compounds was not detected. The producer does not indicate the presence of tannins in the chemical composition of Citrosept, as opposed to *Scutellaria baicalensis* root extract.

Tables 2–4 present the results concerning the content of mineral elements in blood plasma of birds which were under the influence of active substances included in the applied and tested plant preparations.

The concentration of sodium in the blood of 9-week-old turkey hens from group II was significantly lower by 11.7%, compared to control group ($p=0.0033$) (Tab. 2).

After 2 consecutive weeks of research, significantly higher levels of sodium by 11.9%, 16.6%, 19.4% and 10% were recorded in groups II, IV, VI–VII respectively, compared to the control group ($p \leq 0.01$) (Tab. 3). Next, at the end of rearing (15th week of bird's life) a highly significant drop in the content of this macroelement was confirmed by 11.9%, 5.5% and 5.4% in turkey hens from groups IV–VI, respectively, compared to the control group ($p \leq 0.01$) (Tab. 4).

A highly significant decrease in the potassium levels by 19.6% and 28% were recorded in 9-week-old turkey hens from groups III and IV, which received different dosages of Citrosept, compared to the birds from the control group ($p \leq 0.01$) (Tab. 2). The concentration of this element in the blood of 15-week-old birds from group VI was highly significantly lower by 17.6%, in comparison with the control

Table 2. Content of mineral elements in blood plasma in 9-week-old turkey hens in the control group (C) and groups given a Citrosept preparation addition (II–IV) and *Scutellaria baicalensis* root extract (V–VII)

Property	Control group	Research groups						SEM
	C	II	III	IV	V	VI	VII	
Na, mmol·l⁻¹	138.21^{A}	121.99^{B}	145.10^{A}	141.91^{A}	144.77^{A}	140.51^{A}	138.62^{A}	1.701
K, mmol·l⁻¹	3.97^{AB}	4.11^{A}	3.19^{CD}	2.86^{D}	3.46^{BCD}	3.92^{AB}	3.76^{ABC}	0.086
Ca, mmol·l⁻¹	2.76	2.78	2.77	2.74	2.83	2.84	2.96	0.031
Mg, mmol·l⁻¹	0.72	0.77	0.75	0.72	0.76	0.74	0.75	0.006
Cu, µmol·l⁻¹	2.90^{ABC}	3.26^{AB}	3.38^{AB}	2.54^{BC}	2.23^{C}	3.14^{ABC}	3.56^{A}	0.104
Zn, µmol·l⁻¹	20.75^{B}	19.40^{B}	19.67^{B}	19.85^{B}	20.63^{B}	23.39^{AB}	26.99^{A}	0.527
Fe, µmol·l⁻¹	38.97^{A}	20.10^{BC}	26.37^{B}	26.56^{B}	21.17^{BC}	20.50^{BC}	15.51^{C}	1.256

$^{A, B, C, D}$ – statistically significant differences of average values in lines are indicated by different letter markings for the probability p≤0.01

Table 3. Content of mineral elements in blood plasma in 11-week-old turkey hens in the control group (C) and groups given a Citrosept preparation addition (II–IV) and *Scutellaria baicalensis* root extract (V–VII)

Property	Control group	Research groups						SEM
	C	II	III	IV	V	VI	VII	
Na, mmol·l⁻¹	118.63^{D}	132.77^{ABC}	127.06^{BCD}	138.35^{AB}	123.05^{CD}	141.68^{A}	130.54^{ABC}	1.527
K, mmol·l⁻¹	3.41^{AB}	3.80^{A}	3.53^{AB}	3.04^{B}	3.37^{AB}	3.38^{AB}	3.13^{AB}	0.068
Ca, mmol·l⁻¹	2.46	2.62	2.54	2.56	2.48	2.67	2.67	0.035
Mg, mmol·l⁻¹	0.77^{CD}	0.75^{D}	0.77^{CD}	0.82^{BC}	0.89^{A}	0.85^{AB}	0.87^{AB}	0.010
Cu, µmol·l⁻¹	2.89^{ABC}	3.20^{AB}	2.32^{C}	2.77^{ABC}	3.52^{A}	2.56^{BC}	2.88^{ABC}	0.085
Zn, µmol·l⁻¹	25.61^{BC}	26.89^{BC}	25.43^{C}	29.62^{AB}	28.37^{ABC}	28.76^{ABC}	31.12^{A}	0.458
Fe, µmol·l⁻¹	18.71^{B}	32.37^{A}	26.79^{AB}	21.55^{B}	26.40^{AB}	34.33^{A}	27.18^{AB}	1.131

$^{A, B, C, D}$ – statistically significant differences of average values in lines are indicated by different letter markings for the probability p≤0.01

Table 4. Content of mineral elements in blood plasma in 15-week-old turkey hens in the control group (C) and groups given a Citrosept preparation addition (II–IV) and *Scutellaria baicalensis* root extract (V–VII)

Property	Control group	Research groups						SEM
	C	II	III	IV	V	VI	VII	
Na, mmol·l⁻¹	141.05^{A}	141.20^{A}	139.58^{AB}	124.24^{C}	133.27^{B}	133.44^{B}	136.75^{AB}	1.057
K, mmol·l⁻¹	4.04^{A}	3.56^{AB}	3.56^{AB}	4.07^{A}	4.02^{A}	3.33^{B}	3.51^{AB}	0.069
Ca, mmol·l⁻¹	2.82^{b}	3.01^{ab}	2.98^{ab}	2.88^{ab}	3.00^{ab}	3.03^{ab}	3.16^{a}	0.038
Mg, mmol·l⁻¹	0.86^{AB}	0.80^{B}	0.88^{AB}	0.86^{AB}	0.92^{AB}	0.82^{AB}	0.93^{A}	0.012
Cu, µmol·l⁻¹	3.46^{A}	3.34^{AB}	3.03^{AB}	2.93^{B}	3.25^{AB}	3.11^{AB}	3.41^{A}	0.049
Zn, µmol·l⁻¹	34.99^{A}	34.27^{AB}	28.47^{BC}	26.99^{C}	28.47^{BC}	37.10^{A}	33.05^{ABC}	0.776
Fe, µmol·l⁻¹	38.47^{A}	27.50^{B}	38.15^{A}	29.75^{AB}	29.23^{AB}	24.64^{B}	23.41^{B}	1.172

$^{a, b}$ – statistically significant differences of average values in lines are indicated by different letter markings for the probability value p≤0.05
$^{A, B, C}$ – statistically significant differences of average values in lines are indicated by different letter markings for the probability p≤0.01

group (p=0.0053) (Tab. 4). Thus, it can be stated that the age of birds at which the extracts from immunotropic were administered, as well as the length of the application period of these preparations, the highest dosage of Citrosept and the lowest dosage of *Scutellaria baicalensis* root extract influenced the changes in the level of elements in blood plasma. This in turn might also have influenced – apart from other immunostimulators present in the preparations administered to the birds – immunological reactions in their organisms [20].

The majority of authors interpret the research results regarding the content of mineral elements in poultry blood on the basis of their content in herbs given to the birds, relying mostly on elements such as: calcium, magnesium, iron, and phosphorous, less often copper, zinc and potassium.

On the other hand, the field literature concerning the influence of plant additions on the content of sodium in poultry blood, especially in turkeys, was not found.

In the research by Makarski and Polonis [21], as well as Sembratowicz et al. [22], no significant differences were recorded with regard to the level of potassium in the tested preparations and mixtures made of herbs. The concentration of this element in blood plasma in the groups of turkeys which underwent the experiment was within broad limits, from 239.3 mg·dm^{-3} after adding Biostymina preparation to 633.0 mg·dm^{-3} after a herbal mixture. Due to the fact that field literature describing this macroelement, which may be found in herbs, is scarce, it is more difficult to interpret the results of the presented study with the results of the authors cited above. However, it should be noticed that higher concentration of this macroelement was recorded in the blood of turkeys given the herbal mixture, but not single herbs. In the presentrd study, in order to emphasis the favourable influence of potassium contained in preparations applied to turkeys *per os* on its content in the blood of tested birds, perhaps an additional group of turkey hens should have been added and given a composition of 2 plant extracts on the basis of white grapefruit and *Scutellaria baicalensis*. Nevertheless, this will be the subject for further experiments in this scope.

After 10 weeks of research, a significant increase of calcium level by 12.1% was proved under the influence of the biggest dosage of *Scutellaria baicalensis* root extract (group VII), compared to the control group (p=0.0403) (Tab. 4). It seems that this slight hypercalcaemia might have been the result of more efficient calcium resorption in the alimentary tract, possibly triggered by the addition of the biggest dosage of this preparation. An upward tendency of this element was also recorded in other groups of birds instilled with the *Scutellaria baicalensis* root extract to water (3.00 – 3.03 mmol·l^{-1}) and Citrosept (2.88 –3.01 mmol·l^{-1}). The high level of calcium in the blood of bird given grapefruit extract, suggests that the vitamin C contained in this preparation, together with other active substances, did not negatively influence the absorption of this element in the bowels.

This corresponds with the results obtained by Króliczewska and Zawadzki [23], who recorded on the 42nd day of an experiment a statistically significant increase of the level of calcium in blood in groups of tested birds which were given a mixture of 10g and 15g of a fragmented *Scutellaria baicalensis* root. The increase of content of this element in the blood of turkeys given herbal extracts was also proved in previous research by Sembratowicz [24]. Also, research by Makarski and Polonis [21] proved that the application of a 1% addition of a herbal mixture to the feed considerably influenced the increase in the calcium and magnesium levels in birds' blood. Similarly, statistical differences in the concentration of calcium in blood were observed in other research, e.g. in calves fed with mineral-herbal mixtures, applied as an addition to feeds [25].

After discontinuation of the experimental additions, a highly significant increase in the content of magnesium in the blood of 11-week old birds from groups V–VII was proved by 15.6%, 10.4% and 13%, respectively, compared to the control group (p≤0.01) (Tab. 3).

The content of copper in the blood of 15-week old turkey hens (group IV) was highly significantly lower by 15.3%, compared to birds from the control group (p=0.0047) (Tab. 4).

After 4 and 6 weeks of research (Tab. 2, 3) the level of zinc in turkeys' blood from group VII was highly significantly higher by over 30% (p=0.0001) and 20% (p=0.0008), respectively, compared to the control group. During the15th week of rearing in groups III–IV, a highly significant decrease in the concentration of zinc in birds' blood was recorded by 18.6%, 22.9% and 18.6%, respectively, compared to the control group (p≤0.01) (Tab. 4).

Sembratowicz et al. [22] proved the influence of a higher level of copper in Bioaron C preparation on a significant increase of the level of this element in birds' blood. Undoubtedly, a big influence on the concentration of this element in birds' blood, in the conducted research by the above-mentioned authors, was played by the presence of active substances contained in extracts from aloe and with an addition of ascorbic acid. This was not proved by the results of the presented research which concerned the biggest dosage of Citrosept preparation.

In research by Makarski and Polonis [21], the applied herbal mixture, which consisted of yarrow, shepherd's-purse, common horsetail, head of common marigold, fruit of hawthorn and aronia pulp, as well as leaves of stinging nettle, influenced a significant decrease in the level of copper in birds' blood. Perhaps in the conducted experiment described in the presented study, active substances contained in herbs (white grapefruit and *Scutellaria baicalensis*) given to turkey hens *per os* caused a lower absorption of this element in blood, similarly to other herbs in the experiment carried out by the above-mentioned authors.

In research by Truchliński et al. [10] the application of another addition in the form of an extract from raw garlic caused a significant increase in the concentration of zinc in birds' blood. However, Makarski and Polonis [21], and Sembratowicz *et al.* [22], did not prove a significant influence of extracts and herbal mixtures on the level of this element in slaughter turkeys' blood.

Turkey hens which during the 9th week of life were given different dosages of the tested plant extracts, were characterised by a highly significantly lower level of iron in the blood by over 48%, 32% and 31%, respectively (for Citrosept) and by 45%, 47% and 60% (for the *Scutellaria baicalensis* root extract), compared to the control group (p≤0.01) (Tab. 2). In the 2-week period of break from the application of preparations, a highly significant increase of iron in birds' blood from groups II and VI was recorded by over 70% and 80%, respectively, compared to the control group (p≤0.01) (Tab. 3). During the 15th week of life of the turkey hens, a highly significant decrease in this element was proved in the blood of the birds which were given the lowest dosage of grapefruit extract by 28.5%, as well as the initial and the biggest dosage of the *Scutellaria baicalensis* root extract by 36% and 39%, respectively, compared to the control group ((p≤0.01) (Tab. 4). The tendency to increase the concentration of iron in group III might indicate slightly better absorption of this element from the alimentary tract, as well as the limitation of secretion from the organism caused by biologically-active factors present in the plant preparation tested and eaten by turkey hens.

Króliczewska and Zawadzki [23] during a similar experiment did not record the influence of an addition of the *Scutellaria baicalensis* root extract to the feed eaten by broiler chickens on the level of iron in blood of these birds. However, at the end of the conducted research, after adding to the feed the highest amount of *Scutellaria baicalensis* root (15g), they recorded a highly significant increase in the content of this element in the blood of tested birds.

CONCLUSIONS

The obtained research results allow the drawing of the following conclusions:

The use of Citrosept and *Scutellaria baicalensis* root extract influenced changes in the levels of all designated elements in blood plasma of turkey hens. However, these changes were not unequivocal in all groups of tested animals. An upward tendency was recorded with regard to the level of calcium and magnesium, and a downward tendency of sodium, potassium, copper, zinc and iron, in relation to the results obtained in the control group.

The conducted experiment did not allow determination of the most effective dosage of the tested preparations in relation to the increase in level of the analysed mineral elements in blood plasma of turkey hens.

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