J. Elementol. 2009, 14(3): 539–544

EFFECT OF VARIOUS DOSES OF OAT ADDED TO A FEED MIXTURE ON THE CONTENTS OF SELECTED MINERALS IN TURKEY MEAT

Janusz F. Pomianowski[1], Teresa Majewska[2], Jerzy Borowski[3], Wacław Mozolewski[1]

[1]Chair of Commodity Science and Food Analysis
[2]Chair of Poultry Science
[3]Chair of Human Nutrition
University of Warmia and Mazury in Olsztyn

Abstract

Owing to its high protein and low fat content, turkey meat is regarded as dietetic. It also has a beneficial composition in terms of amino acid and mineral content.

The study involved an analysis of selected elements: zinc, magnesium, calcium, sodium, potassium and phosphorus in breast muscles of male turkeys BIG 6 fed on fodder with various content of oatmeal (0%; 5% and 10%).

The content of selected elements was determined in previously mineralised samples: zinc, magnesium and calcium – by AAS, using a UNICAM 939AAA Solar flame atomic absorption spectrometer; sodium and potassium – by flame photometry with a Carl Zeiss Jena FLAPHO 4 flame photometer, and phosphorus – by colorimetric measurement with the hydroquinone reagent at a wavelength of 610 nm. The results were processed with a single-factor analysis of variance with the Statistica 8pl computer program, and the significance of differences was determined with Duncan's test.

Oatmeal application in the analysed doses in turkey feeding has been shown to reduce the content of the elements under study in turkey meat. The differences for the analysed elements have not been shown to be statistically significant (P = 0.05), except for sodium, whose content – unlike that of other elements – grew with the oatmeal content in the fodder

Key words: turkey meat, mineral components, feed mixtures.

dr inż. Janusz F. Pomianowski, Chair of Commodity Science and Food Analysis, University of Warmia and Mazury in Olsztyn, pl. Cieszyński 1, 10-726 Olsztyn, e-mail: janusz.pomianowski@uwm.edu.pl

WPŁYW ZRÓŻNICOWANEGO UDZIAŁU OWSA W PASZY NA ZAWARTOŚĆ WYBRANYCH PIERWIASTKÓW W MIĘSIE INDYCZYM

Abstrakt

Mięso indycze ze względu na dużą zawartość białka i małą ilość tłuszczu uznaje się za dietetyczne. Ponadto ma ono korzystny skład aminokwasowy i mineralny.

W pracy analizowano zawartość wybranych pierwiastków: cynku, magnezu, wapnia, sodu, potasu i fosforu w mięśniach piersiowych indorów BIG 6 żywionych paszą o różnym udziale śruty owsianej (0%; 5% i 10%).

Zawartość wybranych pierwiastków oznaczano w uprzednio zmineralizowanych próbkach: cynk, magnez i wapń – metodą ASA, stosując spektrofotometr płomieniowej absorpcji atomowej UNICAM 939AAA Solar; sód i potas – metodą fotometrii płomieniowej z użyciem fotometru płomieniowego FLAPHO 4 firmy Carl Zeiss Jena, fosfor – metodą kolorymetryczną z zastosowaniem odczynnika hydrochinonowego przy długości fali 610 nm. Wyniki poddano jednoczynnikowej analizie wariancji stosując program komputerowy Statistica 8pl, a istotność różnic oceniono testem Duncana.

Wykazano, że stosowanie śruty owsianej w skarmianiu indyków w ocenianych dawkach wpływa na obniżenie ilości badanych pierwiastków w mięsie indyczym. Nie wykazano, by różnice te były istotne statystycznie ($P \leq 0.05$) dla analizowanych pierwiastków, z wyjątkiem sodu, którego ilość w odróżnieniu od innych pierwiastków wzrastała wraz ze wzrostem ilości stosowanej śruty owsianej w paszy.

Słowa kluczowe: mięso indycze, składniki mineralne, pasza.

INTRODUCTION

Due to a high content of protein and a low content of fat, turkey meat is recognized as dietetic. It is additionally characterized by a beneficial amino acid and mineral composition. It contains considerable amounts of potassium, magnesium, zinc and selenium with a relatively low content of sodium. In the breeding practice of these birds, a number of producers have used feed mixtures similar to those for hens. This practice, however, seems to be inappropriate owing to the different behavior of these birds, the different pH value of their alimentary tract and susceptibility to a number of diseases.

Likewise, millet oat is a cereal known for its high content of minerals (ranging from 2% to 3.4%). It is also characterized by high contents of zinc and soluble silica. Owing to the above, as well as to high contents of dietary fibre, oat may be applied as feed for turkeys, which show a considerable demand for dietary fibre (BARTNIKOWSKA et al. 2000ab, MAJEWSKA et al. 2004).

The study was aimed at evaluating the effect of varied feeding of turkeys with feed mixtures containing different doses of oat on contents of selected minerals in their meat.

MATERIAL AND METHODS

The experimental material were breast muscles of heavy BIG 7 turkey toms originating from a feeding experiment conducted at a poultry farm of the Chair of Poultry Science, Faculty of Animal Bioengineering, University of Warmia and Mazury in Olsztyn. The birds were fed *ad libitum* pelleted feed mixtures in a 3-variant system. Three feeding groups were established: (A) control group without addition of oat, group (B) with 5% addition of oat meal, and group (C) with 10% addition of oat meal to a feed mixture. The protein value and energy value of the feed mixtures were consistent with dietary requirements for slaughter turkeys at respective stages of growth (SMULIKOWSKA, RUTKOWSKI 2005). After termination of the feeding experiment, 8 birds with body weights similar to the average were selected from each group, fasted for 12 h and slaughtered. After 24-h chilling at a temperature of 4ºC, their carcasses were weighed and subjected to dissection. For analyses, *ca* 200 g of samples were collected from the breast muscle. Portions of meat were packed into PE foil bags and transferred to the Chair of Commodity Science and Food Analysis, University of Warmia and Mazury in Olsztyn, for further analyses.

Comminuted samples of meat were weighed and wet-mineralized in a mixture of HNO_3 and $HClO_4$ (at a 3:1 ratio). The mineralization was conducted in a block by the Tecator company with a programmed temperature.

Contents of selected minerals in the resultant mineralizate were determined as follows:

– zinc, magnesium and calcium – with the AAS method using a UNICAM 939AAA Solar flame atomic absorption spectrophotometer,
– sodium and potassium – with the method of flame photometry by means of a FLACHO 4 flame photometer by Carl Zeiss Jena,
– phosphorus – with the colorimetric method using a hydroquinone reagent at a wavelength of 610 nm.

The results were subjected to a one-way analysis of variance using Statistica 8pl software, and the significance of differences was evaluated with Duncan's test.

RESULTS AND DISCUSSION

The results of analyses are presented in Table 1. Out of all minerals analyzed, the breast muscles of turkeys had the highest content of potassium. Mean concentrations of this element in the samples examined varied between 360.78 mg 100 g^{-1} in meat of the turkeys fed a feed mixture with the highest 10% dose of oat (group C) and 385.90 mg 100 g^{-1} in meat of the

Table 1

The content of elements in turkey breats (mg 100 g^{-1})

Element	Statistical measures	Feeding group		
		A	B	C
Zinc	mean	0.93	0.83	0.80
	range	0.85 – 1.01	0.75 – 0.91	0.72 – 0.91
	SD	0.08	0.13	0.10
Magnesium	mean	23.77	23.25	22.94
	range	22.12 – 24.72	21.37 – 24.27	21.67 – 24.79
	SD	1.43	3.45	2.07
Calcium	mean	1.85	1.78	1.65
	range	1.69 – 2.06	1.60 – 1.92	1.40 – 1.90
	SD	0.19	0.22	0.27
Sodium	mean	59.47a	63.46b	66.89a
	range	57.46 – 61.64	61.69 – 65.72	62.43 – 69.41
	SD	2.10	2.06	3.87
Phosphorus	mean	247.93	244.08	240.82
	range	236.90 – 252.75	240.75 – 248.90	234.80 – 245.30
	SD	7.93	9.99	24.31
Potassium	mean	385.90	374.72	360.78
	range	384.20 – 387.30	356.75 – 385.40	351.95 – 365.60
	SD	1.21	9.46	7.66

Statistically significant differences at $P \leq 0.05$.

birds fed a feed mixture without oat addition (group A). Generally, analyses demonstrated a decrease in potassium content of meat along with an increasing dose of oat meal in feed mixtures. Similar observations were made for phosphorus, the content of which ranged from 240.82 mg 100 g^{-1} in meat of the birds from group C to 247.93 mg 100 g^{-1} in meat of the control toms (group A). However, the statistical analysis of the above results demonstrated a lack of significant differences in contents of both potassium and phosphorus between the feeding groups of birds.

In assaying sodium, oat meal addition to feed mixtures was observed to produce a significant effect on its concentration in meat, which ranged from 59.47 mg 100 g^{-1} in meat of the birds fed a feed mixture without oat addition (group A) to 66.89 mg 100 g^{-1} in meat of the birds receiving 10% oat meal in their feed mixture (group C). These differences turned out to be statistically significant (P=0.05). Adverse relations were observed for the magnesium content of meat. The highest mean content of this element (23.77

mg 100 g^{-1}) was determined in meat of the toms fed a feed mixture without an oat meal addition (group A), a slightly lower one (23.25 mg 100 g^{-1}) in meat of the turkeys fed a feed mixture with a 5% dose of oat meal (group B), and the lowest (22.63 mg 100 g^{-1}) in meat of the birds receiving a 10% dose of oat meal in the feed mixture (group C).

The second most abundant element in the meat examined was calcium. In this case, the results of assays also appeared to be differentiated depending on the feed mixture administered to birds. The lowest content of this element (1.65 mg 100 g^{-1}) was determined in meat of the birds fed a mixture with the highest dose of oat meal (group C), a slightly higher one (1.78 mg 100 g^{-1}) in meat of the turkeys from group B fed a feed mixture with a 5% dose of oat meal, and the highest one (1.85 mg 100 g^{-1}) in meat of the control birds (group A). However, the differences observed were not proven to be statistically significant.

Out of all elements assayed, the lowest concentrations were reported for zinc. The highest content of this element (0.93 mg 100 g^{-1}) was determined in meat of the control birds (group A), whereas its lower contents were observed in meat of the toms fed feed mixtures containing oat meal, i.e. 0.83 mg 100 g^{-1} and 0.80 mg 100 g^{-1} in the birds fed feed mixtures with 5% (group B) and 10% (group C) of oat meal, respectively. Nevertheless, the differences between the feeding groups were not statistically significant.

Similar concentrations of the elements examined were reported by other authors [Bojarska et. al 2000], who evaluated the contents of minerals in carcasses and muscles of turkeys. Those authors point to the possibility of decreasing contents of the elements along with the age of the birds. In addition, they emphasize differentiated concentrations of those elements as affected by the type of muscle. The results obtained in that study are also consistent with "Food Composition Tables" (Kunachowicz et al. 2005). The few discrepancies occurring between the results are likely to stem from the fact that the authors had expressed the contents of particular elements in respect of the whole carcass. Those discrepancies refer to potassium, sodium and magnesium (whose contents determined in the reported study were slightly higher) and to zinc (whose content was slightly lower). Such low concentrations of zinc in the breast muscles of turkeys were also reported in a study by Nadolna et al. (1996) on the nutritive value of chickens and turkeys.

A comparative analysis of contents of the elements examined in meat of turkeys with those found in beef and meat of ostrich demonstrates considerable differences (Sales, Oliver-Lyons, 1996). Other authors (Al-Najdawi, Abdullah 2002), who examined chickens from the Jordanian market, indicate remarkably higher contents of the assayed elements in the meat of chickens as compared to that of turkeys. Worthy of notice are also differences in the concentrations of individual mineral substances as affected by the type of muscle examined or origin of birds (Gardzielewska et al. 1997).

SUMMARY

The applied feed mixtures with various doses of oat meal were found to affect the contents of elements in the meat samples examined. However, the statistical analysis proved their significant effect only on the increased content of sodium (P = 0.05). In the other samples, no significant effect of the oat meal dose applied was shown on either an increase or decrease in the concentrations of the assayed micro- and macroelements.

REFERENCES

AL.-NAJDAWI R., ABDULLAH B. 2002. *Proximate composition, selected minerals, cholesterol content and lipid oxidation of mechanically and hand-deboned chickens from the Jordanian market*. Meat Sci., 62:243-247.

BARTNIKOWSKA E., LANGE E.; RAKOWSKA M. 2000a. *Ziarno owsa - niedoceniane źródło składników odżywczych i biologicznie czynnych.* Cz. I. *Ogólna charakterystyka owsa. Białka, tłuszcze [Oat grain – an undervalued source of nutrients and biologically active components.* Part I. *General description of oat. Proteins, fats].* Biul. IHAR, 215:209-222. [in Polish]

BARTNIKOWSKA E., LANGE E., RAKOWSKA M. 2000b. *Ziarno owsa – niedoceniane źródło składników odżywczych i biologicznie czynnych.* Cz. II. *Polisacharydy i włókno pokarmowe, składniki mineralne, witaminy [Oat grain – an undervalued source of nutrients and biologically active components*. Part II. *Polysaccharides and fibre, mineral components, vitamins].* Biul. IHAR, 215: 223-237. [in Polish]

BOJARSKA U., BATURA J., MARKIEWICZ K. 2000. *Zawartość składników mineralnych w tuszkach i mięśniach indyków [Content of minerals in carcasses and muscles of turkeys].* Zesz. Nauk. PTZ Prz. Hod., 49:267. [in Polish]

GARDZIELEWSKA J., SOCHACKA A., GOLACH Z., CYRAN A., NATALCZYK-SZYMKOWSKA W. 1997. *Mięso kurcząt brojlerów jako źródło magnezu, sodu, potasu, wapnia, fosforu i litu [Broiler chicken meat as a source of magnesium, sodium, potassium, calcium, phosphorus and lithium].* Zesz. Nauk. AR Szczecin, Zootechnika, 34:33-38. [in Polish]

KUNACHOWICZ H., NADOLNA I., PRZYGODA B., IWANOW K. 2005. *Tabele składu i wartości odżywczej żywności [Tables of food composition and nutritive value].* PZWL, Warszawa. [in Polish]

MAJEWSKA T., MIKULSKI D., ŚWIĘCICKA-GRABOWSKA G., WÓJCIK R. 2004. *Owies w żywieniu młodych indyków rzeźnych [Oat in nutrition of young slaughterturkeys].* Med. Wet., 60(6): 657-661. [in Polish]

NADOLNA I., KUNACHOWICZ H., IWANOW K, KŁYS W. 1996. *Wartość odżywcza mięsa kurzego i indyczego [Nutritive value of chicekn and turkey meat].* Bezpieczna Żywność, 1-2: 17-20. [in Polish]

SALES J., B. OLIVER-LYONS. 1996. *Ostrich meat: a review*. Food Australia, 48 (11): 504-511.

Zalecenia żywieniowe i wartość pokarmowa pasz. Normy żywienia drobiu. Red. SMULIKOWSKA S., RUTKOWSKI A. 2005. *[Nutritional recommendations and nutritive value of feeds. Nutritional norms for poultry].* PAN, Warszawa. [in Polish]