Mineral Composition of meat being hand separated or mechanically separated from bones

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The work deals with the examination of mineral composition of meat being hand or mechanically separated from bones and deriving from definite anatomic regions of hog, cattle and chicken carcasses. A total of 144 samples was analysed for the contents of calcium, magnesium, iron, nickel, sodium, potassium, phosphorus, cobalt, manganese, selenium, tin, mercury, cadmium, lead, zinc, copper, antimony and arsenic. In addition, the contents of water and ash were determined as well.

The obtained results show that there are considerable differences in the content of minerals among the examined kinds of meat being hand or mechanically separated from bones.

Mineralzusammensetzung des hand- und mechanisch von den Knochen getrenuten Fleisches

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In der vorliegendnen Arbeit wurde die Mineralzusammensetzung des Fleisches untersucht das manuel und mechanisch von den Knochen bestimmter Körperteile der Schweine, Rinder und Hühner getrennt worden war. Es wurden insgesamt 144 Proben analysiert wobei die Angaben über Kalzium-, Magnesium-, Eisen-, Nickel-, Natrium-, Kalium-, Phosphor-, Kobalt-, Mangan-, Selen-, Zinn-, Quecksilber-, Kadmium-, Blei-, Zink-, Kupfer-, Antimon- und Arsengehalt angeführt wurden. In den betreffenden Proben wurde gleichfalls das Wasser- und Aschegehalt festgestellt.

Die dabei erzielte Ergebnisse deuten daraufhin das in dem Mineralgehalt wesentliche Unterschiede vorkommen die für die untersuchten Sorten des mechanisch und manuel von den Knochen getrennten Fleisches gekennzeichnend sind.

II.4

La conposition mineral de la viande désossées à la main ou séparée mécaniquement provenant des os

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Dans cet essai on a examiné la composition mineral de la viande désossées à la main et méchaniquement des regions anatomiques definues des carcasses des porcs, des boeufs et des poules. On a analysé 144 échantillons et déterminé la teneur de calcium, magnésium, fer, nikel, sodium, potassium, phosphore, cobalt, manganese, sélénium, étain, mercoure, cadmium, lead, zinc, cuivre, antimone et arsenic. Dans les échantillons on a déterminé la teneur de l'eau et de graisse.

Les resultats ont montré que les différences entre la composition mineral de la viande désossées à la main ou mécaniquement sont significatives.

Минеральный состав мяса ручно или механически отделенного от костей

ИВАНА ДЖУИЧ, ВЕСЕЛИНКА ДЖОРДЖЕВИЧ , БРАНКО МИХАЙЛОВИЧ и НАДА РАДОВИЧ
ЮГОСЛАВСКИЙ ИНСТИТУТ ТЕХНОЛОГИИ МЯСА, БЕЛГРАД, ЮГОСЛАВИЯ

В данной работе исследован минеральный состав мяса ручно и механически отделенного от костей определенных частей туш свиней, крупного рогатого скота и птиц. Анализировано 144 образцов и предоставлены сведения о содержании кальция, магнезия,железа, никела, натрия,кадмия,фосфора,кобальта, мангана, селена, олова,ртути, кадмия, свиньца, цинка, меди, антимона и арсеника. В этих образцах определялось и содержание воды и пепла.

Полученные результаты показывают что существует большая разница в содержании минералов между мясом механически и мясом ручно отделенным от костей.

Mineral Components of Mechanically Separated Meat

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Introduction

Mechanically deboned meat, namely mechanically separated meat (the term was adopted at the loth Session of the Codex Committee on Processed Meat and Poultry Products, Copenhagen, 20-24 Nov. 1978) is more and more applied in meat industry. The procedure of mechanical separation of meat from bones in poultry industry has been applied for a longer period of time already and from recently it has been increasingly used in the processing of pork and beef as well. Since mechanically separated meat contains muscular, connective and fatty tissues in different relations, dependent on the anatomic region, the majority of works refers to the examination of quality and technological properties of such meat as well as of its liability to oxidative and other changes (1,2,3,4,6,7,9,10,13,14). In addition, there are data on the content of certain mineral components in mechanically separated meat (2,5,6,8,16). However, in the available literature we did not find data on the content of more elements and having in mind their importance in lipid oxidation, we set the task to determine the content of a large number of mineral components in meat removed manually from bones and in mechanically separated meat.

Material and Methods

Legs, shoulders and heads from 24 hours cooled carcasses of domestic white meaty pigs about 7 months old, and of domestic Simmental cattle about 14 months old as well as necks and breasts from 53 days old chickens were used for the examinations. Meat of legs, namely shoulders, was manually removed and gathered, whereas the bones of the same number of anatomic regions of the same animals - os femoris and ossa cruris, namely scapula humerus and ossa antebrachii - were separately collected. Exterior and interior mastication musculature - Mm masseters and pterygoidei - were manually removed from mandibula being previously separated from heads, whereas the bones of lower jaw were collected for mechanical separation. In all experimental groups, the pieces of each individual muscle were taken from the gathered meat, from different places, paying attention that the percentage of individual muscles is proportional to their quantity in the given regions. A certain quantity of muscle mass was minced in the grinder through a 6-7 mm plate and well homogenized. Afterwards, a small portion of the homogenized mass was ground through a 3 mm plate. Homogenized sample closed in a glass container was taken for analysis. Manual removal of meat was done in such way that approximately the same quantity of meat remained on bones so that the percentage of utilization was approximately the same. Mechanical separation of bones was performed in the "Seffelaar and Looyen BV" unit, type MRS 40. The sample of mechanically separated meat was taken immediately after the mass had been well mixed, from a few places in the container. The sample for analysis was then taken from a small quantity of homogenized mass and closed in a glass container. In the case of chicken breasts, meat was removed from bones and afterwards the bones were separated in the "Selo-Bibun" unit, type 16 + 420, the sample for analysis being taken from well homogenized mass. The sample of muscle mass for analysis was obtained in the described way. From a large quantity of necks without skin, there was taken a portion, whereby meat was removed manually and prepared for analysis. The rest was put into the separator whereupon the sample for analysis was taken in the described way.

From each anatomic region of pigs, namely cattle, there were examined 10, namely 8 samples, and in the case of chickens - 9 samples. Water and ash were detemined by standard procedures. The contents of the following mineral components were determined: P, Ca, Mg, Fe, Na, K, Zn, Ni, Co, Cu, Sn, Pb, Cd, Sb, Se, As and Hg. The content of phosphorus was determined spectrophotometrically, with ammonium vanadium molybdate (19), and the contents of other elements

by the atomic absorption spectroscopy. After dry ashing, the contents of calcium (12), magnesium (11), sodium (12), potassium (17), iron (12), nickel (17) and copper (17) were determined by the "Varian" atomic absorption spectroscope, model 1250, in the air-acetylene mixture. Samples for determinations of other elements were mineralized in the mixture of nitric, perchloric and sulphuric acids, in the "Tecator" digestion system, model DS 20. Afterwards, in the air-acetylene mixture, the samples were analysed for the contents of zinc (17), cobalt (12), cadmium (12), lead (11), and antimony (12), making the corrections of non-atomic absorption by means of continuous hydrogen lamp. The content of tin (12) was determined in the acetylene-nitrogen suboxide mixture, and the contents of mercury (18), arsenic and selenium (12) by the application of analysis kit model 64, whereby mercury was determined by flameless method (18) and arsenic and selenium by arsine generation method, namely by hydrogen selenide vapor generation technique (12).

Results and Discussion

The obtained results (Tables 1, 2 and 3) show that the content of ash was higher in mechanically separated meat than in meat removed manually from bones. The increased ash content in mechanically separated meat was followed by the increase of calcium, sodium and iron contents, and to somewhat lower extent by magnesium content, except in the case of pork leg meat. The same regularity, except in chicken breast meat, was observed in the content of phosphorus, being pronounced in meat separated from pork and beef heads and chicken necks. Considerably lower content of potassium was observed in mechanically separated meat than in meat from the same anatomic regions. However, in the case of chicken meat the differences were not so high as in beef and pork, first of all regarding legs and shoulders. Significant increase of iron in mechanically separated meat is indicated by Farmer et al. (5), Watt and Merrill (15), and for magnesium in addition to iron by Chant et al. (2).

Somewhat higher quantities of antimony, cobalt, tin and lead were observed in mechanically separated meat, although this regularity regarding lead and tin was not observed in the case of chicken necks. There were not established differences in the content of selenium between meat removed manually from bones and meat obtained by mechanical separation. This refers also to mercury. Differences in the content of arsenic were small but, nevertheless, slightly higher quantities were found in meat. Lower content of nickel was observed in mechanically separated meat, except in the case of chicken breast meat.

The lowest differences in the contents of the examined elements were found among meats, namely between mechanically separated leg meat and shoulder meat. The differences were much higher between head meat and meats of other anatomic regions. These differences were pronounced regarding the contents of phosphorus, calcium, magnesium, sodium, potassium, tin, antimony, selenium and mercury. Namely, higher quantities of phosphorus, magnesium, potassium and antimony were found in leg meat, whereas the quantities of other listed elements were higher in head meat.

Regarding the contents of phosphorus, cobalt, calcium, and zinc, significant differences were observed between neck meat and breast meat of chickens as well as between mechanically separated meats of these regions. The contents of phosphorus and cobalt were higher in breast meat, whereas calcium and zinc were present in higher quantities in neck meat. Differences in the quantity of zinc between dark and light muscles of chickens were also observed by Zenable and Bowers (16). These authors found differences regarding copper, but our results do not indicate that reliably.

References:

1) Anderson J.T., Gillet T. 1974: J. Food Sci. 39, 1147;
2) Chant J.L., Day L.,Field R.A., Kruggel W.G., Chang Yet-Oy. 1977: J. Food Sci.,42, 2, 306.
3) Cross H.R., Stroud J., Carpenter Z.L., Kotula A.W., Nolan T.W., Smith G.C. 1977: J.Food Sci., 42, 6, 1496;
4) Djordjević V., Trajanoski C., Lazarević J., Nikolić Ž.,Šajber Č. 1978: Zbornik radova, XXVIII savetovanje industrije mesa - Radenci;
5) Farmer R.B., Mahoney A.W., Hendricks D.S., Gillett T.A. 1977: J. Food Sci., 42, 6, 1630.
6) Field R.A. 1976: Food Technol. 30, 9, 38;
7) Fried I. 1976: Food Technol. 30, 9, 35;
8) Kruggel W.G., Field R.A. 1977: J. Food Sci. 42, 190;
9) Lee Y.B., Hargus G.L., Kirkpatrick J.A., Berner D.L., Forsythe R.H. 1975: J. Food Sci. 40, 5, 964.
10) Moerck K.E., Ball H.R. 1974: J. Food Sci. 39, 5, 876;
11) Ramakrishna T.V., West P.W., Robinson J.W. 1968: Anal. Chim. Acta 40, 347;
12) Rowe C.J. 1973: Food Analysis by Atomic Absorption Spectroscopy - Varian Techtron;
13) Vadehra D.V., Baker R.C. 1970:Poultry Sci., 49, 5, 1446;
14) Van Hoof J., Wallays B. 1978: 24 Europäischer Fleischforscher-Kongress, Kongress-dokumentation III, L5, Kulmbach;
15) Watt B.K., Merrill A.L. 1963: Composition of Foods. Raw, Processed, Prepared. USDA Agriculture Handbook No. 8, Washington;
16) Zenoble O.C., Bowers J.A. 1977: J. Food Sci. 42, 5, 1408;
17) 1973. Analytical Methods for flame spectroscopy - Varian Techtron;
18) 1971. Chemistry Laboratory Guidebook - United States Department of Agriculture;
19) 1965. Nordisk Metodik - Komite for levnedsmidler.

CONTENT OF MINERAL COMPONENTS IN PORK AND MECHANICALLY SEPARATED PORK

Table 1.

	MEAT			MECHANICALLY SEPARATED MEAT		
	Leg	Shoulder	Head	Leg	Shoulder	Head
Ash, %	0.89-1.02 0.96	0.94-1.04 0.98	0.61-0.94 0.81	0.89-1.49 1.10	0.96-1.42 1.15	1.14-1.77 1.40
Phosphorus, %	0.219-0.223 0.220	0.194-0.280 0.208	0.084-0.141 0.122	0.198-0.235 0.229	0.167-0.253 0.209	0.157-0.292 0.227
Calcium, mg%	15.02-48.98 26.10	22.20-35.78 26.75	58.00-100.04 77.75	85.25-157.75 121.00	139.10-190.88 151.85	87.22-291.18 182.63
Magnesium, mg%	23.45-27.42 25.44	20.84-24.32 22.60	9.39-16.20 13.42	21.24-28.38 24.39	17.81-32.37 24.96	13.75-18.16 16.82
Sodium, mg%	35.61-43.24 39.32	40.12-55.41 46.21	74.59-97.52 87.45	109.30-190.41 153.53	120.04-214.38 158.68	149.30-240.02 174.90
Potassium, mg%	358.20-505.90 401.12	398.81-572.77 475.75	196.79-445.45 359.75	256.38-383.82 342.24	299.18-465.20 336.69	252.37-406.87 327.81
Iron, mg%	1.39-1.70 1.55	1.07-2.00 1.65	1.14-2.98 2.26	5.25-7.19 6.07	5.68-9.88 7.35	4.54-6.44 5.38
Zinc, mg/kg	18.76-35.19 24.64	22.74-37.74 33.08	12.40-22.38 18.93	13.46-16.41 14.88	12.00-24.11 18.86	12.19-16.05 14.63
Nickel, mg/kg	0.42-0.55 0.49	0.23-0.72 0.49	0.24-0.79 0.50	0.20-0.43 0.21	0.11-0.40 0.18	0.17-0.68 0.35
Cobalt, mg/kg	0.02-0.20 0.04	0.00-0.10 0.04	0.00-0.23 0.12	0.07-0.33 0.21	0.05-0.25 0.17	0.03-0.23 0.09
Copper, mg/kg	0.36-2.11 1.19	0.21-0.72 0.48	0.86-1.05 0.96	0.18-0.98 0.60	0.32-1.00 0.75	1.20-3.25 2.16
Tin, mg/kg	0.84-1.36 1.11	0.12-1.48 0.95	0.74-1.44 1.04	1.34-1.92 1.61	0.74-1.16 1.03	0.64-1.46 1.14
Lead, mg/kg	0.00-0.72 0.18	0.00-0.41 0.16	0.00-0.77 0.43	0.00-1.10 0.59	0.00-1.20 0.71	0.00-1.05 0.45
Cadmium, mg/kg	0.00-0.08 0.02	0.00-0.04 0.02	0.00-0.06 0.03	0.00-0.07 0.02	0.00-0.04 0.01	0.00-0.02 0.01
Antimony, mg/kg	0.00-0.37 0.21	0.00-0.62 0.17	0.00-0.14 0.06	0.00-0.73 0.33	0.00-0.54 0.38	0.00-0.22 1.75
Selenium, mg/kg	0.00-0.12 0.03	0.00-0.10 0.04	0.00-0.14 0.09	0.00-0.06 0.03	0.00-0.06 0.04	0.00-0.08 0.06
Arsenic, mg/kg	0.00-0.82 0.28	0.00-0.70 0.30	0.00-0.77 0.33	0.00-0.42 0.18	0.00-0.37 0.19	0.00-0.45 0.14
Mercury, mg/kg	0.00-0.12 0.02	0.00-0.09 0.03	0.00-0.13 0.05	0.00-0.07 0.03	0.00-0.08 0.04	0.00-0.15 0.07
Water, %	65.26-75.71 72.57	69.52-72.89 71.96	41.48-59.27 53.19	43.86-65.05 54.23	43.29-65.98 57.16	58.64-69.71 66.16