Zusammensetzung von machinell getrenntes Restfleisch von Vorderschinken- und Schinken-Knochen vom Schwein

J. VAN HOOF und BRIGITTE WALLAYS

Institut für Hygiene und Technologie des Fleisches, Tierärztliche Fakultät,
Universität Gent, Belgien - I.W.O.N.L., Brüssel

Machinell getrenntes Restfleisch vom Schwein erhalten mittels eines Separationsverfahrens (Knochenpresse), durchgeführt an einer Vorderschinkenknochenmischung (Scapula, Humerus und Radius + Ulna) zeigt durchaus ein hohes Wasser/Eiweiss-Verhältnis auf. Auf Grund der vorgefundenen Verhältnisse (zwischen 4,50 und 4,94) könnte ein Fremdwassergehalt in Höhe von 6,86 % bis zu 12,67 % errechnet werden (Höchstzulässiger Gehalt = Eiweiss X 4,0).
Der Bindegewebesanteil am Gesamteiweiss betrug etwa 8,9 % bis 12,0 %.
Analysendaten für Fett, Gesamtpigment, Asche und Calcium wurden ebenfalls ermittelt.
Zur Klärung des manchmal erhöhten Wasser- und Fettgehaltes in industriell gewonnenem Restfleisch bei Verwendung von Schweineknochen als Ausgangsmaterial, sowie zur Forschung des natürlichen Knochen/Calcium Verhältnisses wurde die Zusammensetzung der nachfolgenden Teilen ermittelt:

- manuell getrenntes Restfleisch der einzelnen Knochen von Schinken und Vorderschinken
- machinell separiertes Restgewebe der einzelnen Knochen von Schinken und Vorderschinken
- Knochenmark und Knochengewebe der einzelnen Knochen

Aus den Ergebnissen geht hervor dass der hohe Fett- und Fremdwassergehalt auf die Anwesenheit erheblicher Mengen an Knochenmark zurückzuführen ist (14,6 bis 30,8 %).
Der Ca-Gehalt der einzelnen Knochen schwankte zwischen 11,32 und 14,97 %. Bei Berechnung des Knochengehaltes mittels eines Umrechnungsfaktors soll dabei geklärt werden ob Knochen weder als Trockensubstanz oder als natürliches Knochengewebe ermittelt werden soll.

Chemical characteristics of mechanically separated tissue from pork shoulders and hams

J. VAN HOOF and BRIGITTE WALLAYS

Institute of Meat Hygiene and Meat Technology, Faculty of Veterinary Medicine,
State University of Ghent, Belgium - I.W.O.N.L., Brussels

Mechanically separated tissue (MST) obtained by industrial processing (bone press) of bones excised from pork shoulders (scapula, humerus, radius + ulna) usually yields a high water/protein ratio (between 4.50 and 4.94). Consequently the calculated extraneous water content (tolerance = protein x 4.0) may amount upto 6.86 % and 12.67 % respectively.
The amount of other important substances, e.g. collagen, fat, total pigment, ash and Ca of industrially produced MST was also determined.
In order to establish the cause of the high extraneous water- and fat content, as to determine the bone/calcium ratio, chemical analysis was performed on:

- manually separated tissue attached to the surface of the separate bones from hams and shoulders
- MST from the separate bones from hams and shoulders
- bone marrow and bone tissue from the separate bones from hams and shoulders

As a result of this investigation it can be concluded that both the high fat- and the high extraneous water content are highly related to the addition of varying amounts of bone marrow (14.5 to 30.8 %). The calcium content for the separate bones ranged between 11.32 % and 14.97 %. When setting up standards for maximum bone content in MST it should be considered whether bone should be expressed on a dry or on a wet (fresh bone tissue) basis. If intentional addition of extraneous water is excluded, the approximate amount of bone marrow in MST may be calculated fairly from the data obtained for fat content.

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Quelques caractéristiques chimiques de viande de porc séparée mécaniquement, provenant des os de l'épaule et du jambon

J. VAN HOOF et BRIGITTE WALLAYS

Institut d'Hygiène et de Technologie des Denrées Alimentaires d'Origine Animale,
Faculté de Médecine Vétérinaire de l'Université de Gand, Belgique - I.R.S.I.A., Bruxelles

Des os de porc, provenant d'épaules désossées à la main, ont été soumis à l'action d'une presse à os d'un type industriel, afin d'en récupérer les restants du tissu. L'analyse de cette dernière a donné les résultats suivants:

- le rapport eau/protéine se situait entre 4,50 et 4,94
- la teneur en eau soi-disant "additionnée" -calculée sur une relation eau/protéine ≤4,0- variait entre 6,86 % et 12,67 %
- le pourcentage de collagène, déterminé à partir des protéines totales, allait de 8,92 % à 12,00 %
- quelques autres composants, tels que matière grasse, pigment total et calcium ont également été dosés

Une analyse comparative a été faite du tissu récupéré mécaniquement sur chacun des os faisant partie de l'épaule et du jambon ainsi que sur la viande récupérée à la main à partir de la surface des os en question, dans le but de rechercher la cause des pourcentages élevés de matière grasse et d'eau "additionnée", ainsi que pour déterminer la proportion d'os/calcium.

Il est apparu que ce "surplus" d'eau et de graisse proviennent apparament de moëlle, exprimée en quantité (14,6 à 30,8%), lors de la forte pression auxquels sont soumis les os traités mécaniquement. Le rapport: os frais/calcium, établi sur les différents sortes d'os, s'étalait de 6,68 à 8,83.

Lors de la détermination d'un coëfficient pour le calcul de la quantité d'os, en partant de la teneur de calcium, il est indispensable de spécifier sous quelle forme -matière sèche ou fraiche- la matière osseuse doit être prise en considération.

Несколько химических характеристик свиньского мяса механическо отделенного происходящего из кости лопатки и ветчины

Й. Ван Хооф и Брижит Вальляыс

Институт Гигиены и Технологи Продовольственных Товаров Животного Происхождения,
Факультет Ветеринари Гандавского Иниверситета, Бельгия - И.Р.С.И.А. Брюссель

Свиньские кости очищённые ручно происходящие с лопатки были поставлены в костную прасу для получения остальных тканок. Анализ того дал следующий результат:

- пропорция вода/протеина находились между 4,50 и 4,94
- содержание в воду, так называемой добавленой-считаной на пропорции вода/протеина ≤4,0 изменялась между 6,86% и I2,67%
- процент колягена исключены из всех протеин состаял от 8,92% в I2,00%

Анализ сравнения тканок полученых механическо сделано на каждой кости принадлежной в лопатку и венчину и тоже на ручно получёным мясе с поверхности вышеупомянутых кости с целью разыскания причины вышего процента жира и содержания воды, и тоже для удостоверения пропорции кость/кальциум.

Кажется что, перевыполнение воды и жира происходят с костного мозга, в количестве (I4,6 до 30,8%), в результате использования сильной прасы для механическо отделёных кости. Пропорция: свежая кость/кальциум установлённая на разных сортах кости растягивалась от 6,68 до 8,83.

Если коэфициент снимания количества кости был исключён, выходя от содержания кальциум, надо выяснить какая форма - материи сухой или свежой- костной материи нужно принимать во внимание.

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J. VAN HOOF and BRIGITTE WALLAYS

Institute of Meat Hygiene and Meat Technology, Faculty of Veterinary Medicine,
State University of Ghent, Belgium - I.W.O.N.L., Brussels

Introduction

Recovering of residual tissue from manually trimmed bones by mechanical separation procedures becomes current practice. The obtained product, known as mechanically separated tissue (MST) is a highly valuable source of animal protein and of many other nutritious components present in meat as in bone-marrow as well (1, 4, 5, 6, 9, 10).
However, from literature it is also obvious that both yield and composition of MST are highly related to various factors depending on the material used and on the equipment and its way of operation as well (2, 3, 7, 8, 11, 12). Various types of mechanical separators, operating either by a two-stage (grinding + pressing) or by a one-stage procedure (pressing only) are available. The latter one is very common in rendering MST from pork bones.
In the following experiment composition of industrially produced MST which is usually obtained by separation of an uncontrolled mixture of shoulder- and/or ham bones, and of MST rendered by pressing of the separate bones from both parts has been investigated.
Furthermore, the composition from hand separated tissue (HST) adherent to the bones as from bone-tissue and bone-marrow was determined.

Material and Methods

At a meat processing plant pork shoulders and hams were manually boned. Within a 2-4 hrs after rendering, the intact bones were discontinuously transferred by hand into the cylindrical cavity of a bone press (Hydrau-Separator) with a capacity of approximately 20 kgs. During the following pressing operation the bones were compressed at a pressure upto approximately 280 bar.

All MST- and HST-bearing bones were rendered by hand boning of shoulders and hams from fattening pigs which following to slaughter were chilled for 2 days. The internal temperature at the time of boning was ± 7°C.

-MST-samples from blended bones were collected during industrial operation at 4 different processing periods. Sampling occurred in a way that the entire amount of MST from one pressing operation was recovered. The samples were immediately frozen and subsequently stored until final examination at -18°C. Chemical analysis was carried out in duplicate after homogenizing of the samples in a sub-frozen state.

-MST-samples from the separate bones from shoulders or hams originated from the same lot. Samples were collected and handled as described for the blended bones. In order to avoid mutual contamination of MST from the respective bones, three consecutive pressings were made using the same type of bone. The MST from the third pressing was used for chemical examination. Analyses were made in duplicate.

-HST-samples were obtained from bones from the same lots as used for mechanical separation. From each bone type 750 gram-samples were collected. Storage and handling of the samples occurred identically to that of the MST-samples.

-Yellow bone-marrow was sampled on a number of long hollow bones, e.g. the os humerus, femur and tibia.

-After removal of the residual surface meat and the bone-marrow, bone tissue samples were taken by maceration of 3 bones each from the respective bones from hams and shoulders.

Homogenized MST and HST were examined for: moisture (ISO 1442-1973), nitrogen (ISO R937-1969) free fat (ISO 1444-1973), ash (ISO R936-1969), hydroxyproline (ISO/DIS 3469.2), calcium (oxidimetric titration with sodiumpermanganate), total haem-pigment (HORNSEY-method) and pH.
-Except for the determination of hydroxyproline, bone-marrow was examined for the same

compounds as MST and HST.

-Bone tissue was examined for moisture, protein, free fat, ash and calcium.

Results and discussion

The data obtained by chemical analysis of MST of blended shoulder bones are given in Table 1. Although total protein content was quite similar among the MST-samples originating from the different processing periods, data for free fat and moisture were less uniform. Total moisture content was inversely proportionate to the amount of fat present in the different samples. According to the variation in moisture content, the water/protein ratio considerably varied (from 4.50 upto 4.94) among the MST-samples. Consequently the amount of extraneous water as calculated by the formula applied for meat and meat products (max. water content = % protein x 4.0), amounted from 6.86 % to 12,67 %. In all samples data for ash were below 1 % and none of the samples had a calcium content higher than 0.05 %.
From the results obtained for total collagen, collagen content in percentage of total protein varied between 8.95 % and 11.98 %. Total haem-pigment amounted from 482.8 ppm upto 579.7 ppm and pH-values between 6.90 and 7.12 were recorded.

In an attempt to establish a cause for the variation in composition of industrially processed MST the composition of the latter was compared with that of MST rendered by pressing of the separate bones from shoulders (Table 2). At the same time data from MST from pressings of the separate bones from hams were also collected (see also Table 2).
From this table it is obvious that the highest fat- and the lowest protein content were found in MST from the large long hollow bones,e.g. the os femur and tibia (ham) and the humerus (shoulder) containing high amount of yellow bone-marrow. MST-samples from these bones were also characterized by considerable amounts of extraneous water (11.75 upto 15.94 %). This applies also to MST of the os radius (shoulder) containing an extraneous water content upto 13.18 %
On the contrary, high protein and moderate fat content were found in MST from the pelvic bones and the scapula resulting in a reduced amount of extraneous water (1.78 % and 7.61 % respectively). On the other hand ash and calcium content were higher in MST from pelvic bones and scapula than in MST from the other bone types. However, MST from pelvic bones and scapula widely varied by the amount of haem-pigment present. Whereas from all MST-samples haem-pigment was lowest in that from pelvic bones (367.2 ppm) it was by far the highest in that of the scapula (659.6 ppm). The latter may be explained by the spongious structure of the scapula which is rich in red bone-marrow containing high amounts of hematogenous components. Pressing of the pelvic bones and scapula resulted in very high yields (27.4 % and 23.7 % respectively). Yields for the os tibia and radius were very low (7.7 % and 11.3 % respectively) whereas the os femur and humerus showed yields of respectively 18.8 % and 19.4 %.

When comparing the composition of HST (Table 3) with that of MST from the corresponding bones, differences in the amount of the major components are very striking. Although moisture content of HST is significantly higher than that of MST, the water/protein ratio ranged between 3.55 and 3.86 only due to the considerably increased protein content.
HST from all of three shoulder bones was inferior in quality when comparing the collagen content with that of MST. Percentages of collagen in relation to total protein in HST from the scapula, the os humerus and radius were 6.93 %, 17.57 % and 20.62 % respectively for 5.81 %, 10.94 % and 12.86 % in the MST. On the contrary, collagen as percentage of total protein was somewhat higher in MST than in HST from the ham bones.

Some evidence for the impairing effect of the addition of yellow bone-marrow occurring by breaking and pressing of the long hollow bones on the composition of MST is given in Table 4. Analyzing the data for fat content of HST and MST on the one side and those for fat content of yellow bone-marrow on the other, the amount of the latter in MST may approximately be calculated. Amounts upto 25-30 % are frequently found in MST from some types of long bones.

Analytical data for bone composition as given in Table 5 indicate that the bone/calcium ratio slightly varied among the respective bone types with an average value of 8.01 ±0.85 for fresh bone tissue and of 5.49 ±0.34 when calculated on dry matter. These figures are not in accordance with the current USDA regulations providing a calculation of bone content in MST of red meat by the formula: bone content = (Calcium content of MST - 0.015 %) x 4. In accordance with data given by other authors (1), calcium content in ash was quite constant and amounted to averagely 37.10 % ±0.55.

Conclusions

The high amounts of fat and extraneous water in MST from pork shoulder and ham bones is mainly related to the type of bone used for rendering of the MST, e.g. long bones or flat spongious bones. Addition of large quantities of the larger long bones has a detrimental effect on the quality of the product by increasing both fat- and extraneous water content. However, due to the particular composition of MST including inevitable amount of bone-marrow, chemical specifications for MST should be established in accordance with good manufacturing practices applicable to this type of raw material. In relation to the examination for bone content, determination of calcium content should be preferred as long as no generally accepted procedure for the calculation of bone tissue has been developed.

sample		1	2	3	4
moisture	(%)	66.55	65.21	63.23	61.74
protein	(%)	13.47	13.19	13.10	13.72
fat	(%)	19.25	20.61	22.09	24.05
ash	(%)	0.92	0.94	0.77	0.92
collagen	(%)	1.42	1.18	1.57	1.63
calcium	(%)	0.049	0.050	0.043	0.039
haem-pigment	(ppm)	567.8	567.8	482.8	579.7
pH		7.12	6.90	6.90	7.00
water/protein		4.94	4.94	4.83	4.50
extraneous water	(%)	12.67	12.45	10.83	6.86

Table 1 : Composition of mechanically separated tissue from pork shoulder bones, sampled at 4 different processing periods (1 to 4)

bone type		1	2	3	4	5	6
moisture	(%)	62.50	59.94	56.95	65.81	60.40	65.06
protein	(%)	15.18	11.00	11.30	14.55	12.03	12.97
fat	(%)	20.91	27.26	30.42	18.37	25.84	20.78
ash	(%)	0.99	0.83	0.82	1.12	0.86	0.88
collagen	(%)	1.51	1.14	1.90	0.84	1.32	1.67
calcium	(%)	0.041	0.032	0.030	0.063	0.034	0.038
haem-pigment	(ppm)	367.2	584.8	404.6	659.6	598.4	540.6
pH		6.73	6.96	7.01	6.95	7.01	7.04
water/protein		4.12	5.45	5.04	4.52	5.02	5.02
extraneous water	(%)	1.78	15.94	11.75	7.61	12.28	13.18

identification of the bones:

1 = pelvic bone
2 = femur
3 = tibia + fibula
4 = scapula
5 = humerus
6 = radius + ulna

Table 2 : Composition of mechanically separated tissue from the separate bones from pork shoulders and hams

bone type	1	2	3	4	5	6
moisture (%)	70.98	69.29	73.51	73.04	70.25	70.73
protein (%)	19.99	18.20	19.05	18.94	18.78	18.80
fat (%)	8.35	11.99	6.86	7.58	10.73	10.12
ash (%)	1.07	0.94	1.03	1.05	0.96	0.87
collagen (%)	1.36	1.39	2.16	1.31	3.30	3.88
calcium (%)	0.016	0.016	0.013	0.025	0.014	0.014
haem-pigment(ppm)	127.2	118.3	119.0	127.8	105.4	91.1
pH	6.50	6.50	6.48	6.80	6.80	6.71
water/protein	3.55	3.81	3.86	3.86	3.74	3.76
extraneous water(%)	-	-	-	-	-	-

Table 3 : Composition of manually separated tissue from the separate bones from pork shoulders and hams. Indentification of the bones: cf. Table 2

bone type	1	2	3
moisture (%)	14.36	12.50	13.67
protein (%)	2.43	2.30	2.65
fat (%)	81.58	83.23	81.46
ash (%)	0.72	0.75	0.93
calcium (%)	0.21	0.20	0.39
haem-pigment(ppm)	158.4	139.4	126.5
pH	7.45	7.50	7.45

Identification of the bones:

1 = femur
2 = tibia
3 = humerus

Table 4 : Composition of marrow from separate long bones

bone type	1	2	3	4	5	6	$\bar{x} \pm s_1$
moisture (%)	34.74	34.91	30.93	27.44	29.46	29.18	31.11 $\pm$3.08
protein (%)	23.42	20.31	22.43	22.55	21.24	21.65	21.93 $\pm$1.10
fat (%)	7.87	8.72	7.33	5.82	9.90	9.30	8.16 $\pm$1.48
ash (%)	29.86	30.54	34.75	37.61	35.76	35.27	33.97 $\pm$3.08
calcium total(%)	10.86	11.21	12.81	13.98	13.52	13.26	12.61 $\pm$1.28
calcium in dry matter (%)	16.53	17.28	18.55	19.27	19.17	18.72	18.25 $\pm$1.10
calcium in as (%)	36.29	36.85	36.86	37.17	37.81	37.59	37.10 $\pm$0.55
bone/calcium ratio							
-on fresh bone	9.21	8.92	7.81	7.15	7.40	7.54	8.01 $\pm$0.85
-on dry matter	6.01	5.81	5.39	5.19	5.22	5.34	5.49 $\pm$0.34

Table 5 : Composition of bone tissue from the separate bones from pork shoulders and hams Identification of the bones: cf. Table 2

Literature

1. CHANT, J.L., DAY, L, FIELD R.A., KRUGGEL, W.G. and YET-OY CHANG: J. Food Sci., 42, 306-309 (1977). 2. FIELD, R.A., RILEY, M.L. and CORBRIDGE, M.H.: J. Food Sci., 39, 282-284 (1974). 3. FIELD, R.A., RILEY, M.L. and CORBRIDGE, M.H.: J. Food Sci., 285-287 (1974). 4. FIELD, R.A.: Food Technol., 9, 38-48 (1976). 5. FRIED, I.: Food Technol., 9, 35-37 (1976). 6. GILLETT, T.A. TANTIKARNJATHEP, K. and ANDREWS, S.J.: J. Food Sci., 41, 766-769 (1976). 7. KASTNER, C.L. and RUSSELL, T.S.: J. Food Sci., 40, 747-750 (1975).

8. KUNSMAN, J.E. and FIELD, R.A.: J. Food Sci., 41, 1439-1441 (1976). 9. LINKE, H., ARNETH, W. and BEM, Z.: Die Fleischwirtsch., 54, 1653-1657, 1660 (1974). 10. NEUHAUSER, S.: Die Fleischwirtsch., 57, 1400 (1977). 11. WIESE, W.: Die Fleischwirtsch., 56, 606-610 (1976). WITTMAN, M.: Die Fleischwirtsch., 57, 1135-1136, 1138-1143, 1261-1262, 1264-1274 (1977).