EFFECT OF REMOVAL OF HAM, LOIN AND SHOULDER FROM PORK SIDES AND OF FREEZING SOON POST MORTEM ON THEIR SHAPE AND SOME CHARACTERISTICS OF MUSCLES

SVETOMIR RAHELIĆ and MILORAD DOSTANIĆ

Faculty of Technology, University of Novi Sad, Novi Sad, Yugoslavia

The influence of the removal of ham, shoulder and loin from the sides of pigs soon post mortem and subsequent freezing on cold shortening appearance as well as on the shape of these cuts and on the changes in the characteristics of muscles has been investigated in this paper.

On the basis of the obtained results it can be concluded that removal of these prime cuts soon post mortem and freezing do not influence significantly on their shapes, although there are certain differences expressed on some cuts - those which were frozen 2 hours post mortem were somewhat shorter than the ones frozen 24 hours post mortem.

The cuts removed and frozen soon post mortem release more drip by thawing than the ones removed and frozen later.

pH_u of m. adductor in the thawed hams removed and frozen soon post mortem was slightly higher than in those removed and frozen later.

Mm adductor, long. dorsi and subscapularis in cuts removed and frozen soon post mortem were darker in colour than in the muscles removed and frozen later post mortem. The same difference in colour appeared both on a surface before freezing and on a surface and sliced surfaces after thawing.

In the most of the removed and frozen muscles soon and later post mortem ATP has not been detected, but in a very few of them it was only in traces.

There have not been found significant differences in the cooked m. long. dorsi taken from the loins and frozen soon and later post mortem neither in the cooked loss and tenderness /Warner - Bratzler/ nor in the tenderness and juiceness while determined sensorily.

INFLUENCE DE LA CONGELATION IMMEDIATE POST MORTEM DU JAMBON, DE L'ECHINE, ET DE L'EPAULE DE PORC DECOUPES DANS LE QUARTIER SUR LEUR FORME ET SUR CERTAINES QUALITES DU MUSCLE

SVETOMIR RAHELIĆ et MILORAD DOSTANIĆ

Faculté de Technologie de l'Université de Novi Sad, Novi Sad, Yugoslavie

On a examiné l'influence de la congelation immédiate post mortem du jambon, de l'échine et de l'épaule de porc découpés dans le quartier sur le raccoursissement /cold shortening/ des morceaux congelés, sur la variation du forme ef sur certaines qualités du muscle.

Les résultats obtenus permettent de conclure que le fait de découper immédiatement post mortem les morceaux cités et de les congeler n'a pas une influence sensible sur leurs dimensions, bien que des différences aient été remarquées sur certains morceaux - certains morceaux congelés 2 heures post mortem sont un peu plus courts que ceux qui ont été congelés 24 heures post mortem. Les morceaux découpés et congelés immédiatement post mortem libérent plus de liquide lorsqu'on les dégele, que les morceaux découpés et congelés plus tard post mortem.

Le pH_u m. adductore des jambons dégelés, découpés et congelés immédiatement post mortem est insensiblement supérieur que dans le même muscle des jambons découpés et congelés plus tard post mortem.

Mm. adductor, long. dorsi et subscapularis des morceaux découpés et congelés immédiatement post mortem sont de couleur plus foncée que ces mêmes muscles des morceaux découpés et congelés plus tard post mortem, et cela aussi bien avant la congélation qu'a la surface et dans la tranche des morceaux dégelés.

Pour la grande majorité des morceaux découpés et congelés immédiatement et plus tard post mortem, ATP n'a pas été constaté et n'a été trouvé qu'en trace pour un petit nombre.

L'examen des morceaux cuits /m. long. dorsi/ de l'échine découpés et congelés immédiatement et plus tard post mortem n'a pas permis d'établir des différences sensibles de perte de poids et de tendresse /Warner-Bratzler/ ni de perte de tendresse et de saveur déterminées par la méthode sensorielle.

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EINFLUSS DER ABTRENNUNG VON KEULE,RÜCKENSTÜCK UND SCHULTERBLATT VON SCHWEINEHÄLFTEN UND IHRES FRÜHEN EINFRIERENS POST MORTEM AUF FORM UND EINIGE MUSKELEIGENSCHAFTEN

SVETOMIR RAHELIĆ und MILORAD DOSTANIĆ

Technologische Fakultät der Universität Novi Sad,Novi Sad, Yugoslavia

In der vorliegenden Arbeit wird untersucht,wie sich Abtrennung von Keule,Schulterblatt und Rückenstück von Schweinehälften auf die Entwicklung der Muskelverkürzung in der Kälte /cold shortening/, als auch auf Formveränderungen dieser Stücke und einige Muskeleigenschaften auswirken.
Auf Grund der Ergebinisse kann geschlossen werden,dass die frühzeitig post mortem erfolgte Abtrennung erwähnter Stücke von den Schweinehälften,sowie ihr Einfrieren,nicht wesentlich auf deren Abmessungen einwirkt,obwohl an einigen Stücken ausgeprägte Unterschiede zu verzeichnen waren - solche 2 Stunden post mortem eingefroren sind etwas kürzer als solche nach 24 Stunden post mortem eingefroren.
Frühzeitig post mortem abgetrennte und eingefrorene Stücke scheiden beim Einfrieren mehr Saft ab,als jene später post mortem abgetrennten und eingefrorenen.
Das pH_u von m.adductor solcher aufgetauten Keulen,die frühzeitig post mortem abgetrennt und eingefroren wurden,ist um ein geringes höher als im gleichen Muskel von später post mortem abgetrennten und eingefrorenen Keulen.
Mm adductor,long.dorsi und subscapularis sind dei frühzeitig post mortem abgetrennten und engefrorenen Stücken dunklerer Färbung als die gleichen Muskeln von später post mortem abgetrennten und eingefrorenen Stücken,und zwar sowohl vor dem Einfrieren,als auch an Flächen und frischem Schnitt von aufgetauten Stücken.
In der grossen Mehrzahl eingefrorener Stücke von frühzeitig und später post mortem abgetrennten und eingefrorenen Stücken ist kein ATP festgestellt worden, während er bei einer kleinen Anzahl in Spuren gefunden werden konnte.
Bei Untersuchung gekochter Muster von m.long.dorsi von frühzeitig und später post mortem abgetrennten Rückenstücken konnten keine wesentilichen Unterschiede,weder im Hinblick auf Gewichts-und Zartheitsverlust /Warner-Bratzler/,noch hinsichtlich sensorisch bestimmter Zartheit und Saftigkeit festgestellt werden.

ВЛИЯНИЕ ОТРЕЗЫВАНИЯ ОКОРОКОВ, СПИН И ЛОПАТОК ОТ ПОЛУТУШ СВИНЕЙ И ИХ ЗАМОРАЖИВАНИЯ РАНО ПОСЛЕ УБОЯ НА ИХ ФОРМУ И НА НЕКОТОРЫЕ СВОЙСТВА МЫШЦ

СВЕТОМИР РАХЕЛИЧ и МИЛОРАД ДОСТАНИЧ

Технологический факультет Университета в Новом Саде, Новый Сад, Югославия

В работе испытывалось влияние отрезывания окороков, спин и лопаток с полутуш свиней рано после убоя и их замораживания на развитие укорачивания мышц на холоде (cold shortening), как и на изменение формы этих частей и на некоторые свойства мышц.

На основании полученных результатов испытаний можно заключить, что отрезывание указанных частей с полутуш рано после убоя и их замораживание не влияет значительно на их дименеии, хотя и были выявлены различия на отдельных частях, а именно: некоторые части,замороженные спустя 2 часа после убоя, были немного короче, чем части, замороженные 24 часа после убоя.

Части, отрезанные и замороженные рано после убоя,выделяют больше сока при размораживании, чем части, отрезанные и замороженные позже после убоя.

pH_um.adductora размороженных окороков, отрезанных и замороженных рано после убоя, было значительно выше,чем в такой же мышце окорока,отрезанного и замороженного позже после убоя.

Mm adductor, long.dorsi и subscapularis на частях, которые были отрезаны и заморожены рано после убоя, имели более темную окраску, чем такие же мышцы на частях, отрезанных и замороженных позже после убоя, и то как до замерзания, так и на поверхности и свежем сечении размороженных частей.

У большинства замороженных образцов с частей, отрезанных и замороженных рано и позже после убоя, не было обнаружено АТФ, а в небольшом числе - только в следах.

При испытании варёных образцов m.long. dorsi со спин,отрезанных и замороженных рано и позже не было обнаружено значительных различий в потери веса и нежности мышц (Warner-Bratzler), как и ни в нежности и сочности этих образцов, определяемых сензорно.

EFFECT OF REMOVAL OF HAM, LOIN AND SHOULDER FROM PORK SIDES AND OF FREEZING SOON POST MORTEM ON THEIR SHAPE AND SOME CHARACTERISTICS OF MUSCLES

SVETOMIR RAHELIĆ and MILORAD DOSTANIĆ

Faculty of Technology, University of Novi Sad, Novi Sad, Yugoslavia

INTRODUCTION

Cold shortening of muscles in sheep and cattle has been well known for more than a decade /6/. The shortening may amount to 60% from the initial length /7/. Meat changed in this way becomes hard.

There are very little data about cold shortening of muscles in pigs. Lewis et al. /4/ quote that slides of mm.psoas major and long. dorsi in pigs become harder if frozen 1o min. post mortem. M. quadriceps femoris does not change at the same conditions of freezing. Galloway and Goll /2/ found that pig muscles, cut in strips shortened mostly when chilled at 2° C /20,4 %/ and at 37° C /21,6%/. However, some muscles did not shorten at the temperature of 2° C. Hendricks et al. found, according to the assertion of Locker et al. /5/ that pig muscles at 20° C may shorten for 14 to 18 %, and at 16° C for 1 to 4%. Marsh et al. /8/ quote that chilling of pig muscles before the appearance of rigor mortis cause qualitatively similar changes in length as in cattle and sheep muscles, but quantitatively they are less. However, the cold shortening does not appear in all muscles. Locker et al. /5/ mentioned that cold shortening in pig muscles has been minimal.

Having in mind the phenomena of cold shortening the question is imposed: if those parts with big muscles, such as ham, shoulder and loin, should change their shape if they are removed from the sides and chilled soon post mortem. From the practical point of view it is interesting to establish if the other parts of the side would change their shape and characteristics if they are sliced and chilled soon post mortem.

Previously mentioned data on cold shortening of muscles in pigs were obtained by the investigations of muscles removed from the sides.

There are very little data about the changes in muscles in those parts which were taken from the sides and frozen soon post mortem.Cosart /1/ quotes that these changes are not significant, but Hinnergardt et. al. /3/ assert that they do not exist at all.

These were the reasons which led us to investigate what is the effect of the removal of ham, shoulder and loins, as well as of other parts from the sides and freezing soon post mortem on their shape and some characteristics of muscles.

INVESTIGATIONS

Material. The sides of 24 Sweden landrace pigs, weight from 1oo to 12o kg. have been investigated in this work.

The pigs were devided in two groups, with 12 individuals in each, and after slaughter and processing, carcasses were cut in two.

Group I. 12 left sides /L_{1-12}/ were cut after the removal of fat, except the one over the ribs, into 6 prime cuts, as follows: 1/ham, 2/ shoulder, 3/ loin, 4/ four rib neck bone, 5/ breast and 6 / ribs with belly. These cuts were removed according to the Regulations for /on/ meat quality /1o/ with slight modifications.

The parts were removed 1 hour post mortem, then measured and weighed, and put on a flat level 2 hours post mortem in order to be frozen at the temperature of - 40°C.

12 right sides /D_{1-12}/ were chilled as usually 24 hours, and then cut in parts which were measured, weighed and frozen as described for the 12 left sides.

Group II. 12 left sides were processed and meat was frozen in quite the same way as the 12 sides of the Group I.

12 right sides/D_{13-24}/ were cut into 6 basical parts as described for 12 left ones, and then these cuts were measured, weighed, put on a flat level and chilled at the temperature of a cold store for 24 hours, and that frozen as described.

After freezing the cuts were put into carton covered inside with polyethilen folia, then closed and stored for 45 to 6o days at - 18°C.

Methods and technique. Measurement of dimensions of prime cuts of sides:

1./ Ham /inside/ a/ from the distal surface of tuberositas mediale tali of tarsal joint to the edge of the cut on hip bone made about 1 cm caudally from tuber coxae, b/ from tarsal joint, as described under a/ to dorsal edge of symphisis ossium ischii, /outside/ c/ from apex patellae to dorso cranial edge of cut made on muscles in the place where ham was parted from loins, d/ from caudal to cranial edge of ham in the area of tuber ischii - maximal width.
2/ Shoulder a/ from the edge of facies articularis carpici of carpal joint to the edge of cartilago scapulae /over cristae scapulae/, b/ from the edge of the joint of arm bone /tuber intermedium humeri/ to caudal cut of shoulder - maximal width.
3/Loin a/ from cranial surface of the 4-th thoracic vertebra to the caudal surface of the 6-th lumbal vertebra. b/ from the edge of m. long. dorsi between feather bones and a cut made on ribs in the part removed as described under a/, c/ the largest height of muscles in the middle of the front surface of loins.

pH was measured in m. adductor about 2 cm. ventrally from symphisis ossium pelvis, in depth of about 1 cm.

Colourwas measured by Göfo apparatus in mm. long. dorsi, adductor and serratus ventralis. It was measured on a surface of muscles before freezing, and on a surface and on surfaces of fresh cuts after thawing.

ATP was determined in samples of the frozen m. adductor by thin layer chromatography on silica gel /silica gel HF 254/, by the method od Potthast and Hamm /9/.

Investigation of cooked muscles. About 130 to 150 g. of m. long dorsi put in polyvinil sacks were cooked in water bath at 90° C until the temperature in the middle of the pisces reached and stayed 80° C.

Cooking loss was calculated on the basis of the weight of pieces before and after cooking.

Tenderness was determined by Warner-Bratzler shear device by a borer of 1/2 inch.

Softness and juiceness were debermined by three persons according to seoring system with the scale from 1 /extremely hard, dry / to 9 /extremely soft, juicy/.

RESULTS AND DISCUSSION

Analyzing the measured dimensions of hams removed 1 hour and frozen 2 hours post mortem /L_{1-24}/ it can be seen that the dimension a /the length/ is significantly decreased /$P < 0,01$/, dimension b as well but a little less /$P < 0,005$/, while the dimension c is not significantly changed during freezing. After thawing of hams these dimensions increase but do not reach the initial values /Table 1a/.

Dimensions of ham, shoulder and loin after removal from the left sides and after freezing, storage and thawing

Table 1a

Basical parts	Samples	Time of measurement after: Removal /1h p.m./ a	b	c^+, d^x	Storage of frozen cuts a	b	c^+, d^x	Thawing a	b	c^+, d^x
Ham	L_{1-12}	52,1	41,7	$32,7^x$	50,0	40,4	$33,8^x$	51,3	41,2	$33,1^x$
	L_{13-24}	49,6	39,8	$29,0^x$	48,0	38,8	$30,1^x$	49,3	39,8	$28,8^x$
Shoulder	L_{1-12}	49,2	29,1	-	47,9	27,4	-	48,7	28,4	-
	L_{13-24}	48,6	29,0	-	47,2	27,6	-	48,3	28,4	-
Loin	L_{1-12}	61,1	59,0	$6,4^+$	61,0	58,6	$6,0^+$	61,0	59,3	$6,2^+$
	L_{13-24}	61,0	59,0	$6,4^+$	61,0	58,6	$6,0^+$	61,0	59,3	$6,3^+$

Decreasing of these dimensions of ham is due to the contraction of muscles do that dimension d /the width/ is increased, i.e. the hams from the left sides widen during freezing, but this change is not statistically significant. During thawing of hams

taken from the left sides dimension a/the length/ is significantly increased /$P < 0,05$/ in samples of the II group /L_{13-24}/, but in samples of the I group /L_{1-12}/, is not the same case. The changes in other dimensions appearing during thawing of hams are also not statistically significant.

Dimensions of those hams which were removed from the sides after chilling for 24 hours do not change significantly during freezing and during thawing /D_{1-12}/. However, in hams removed from the sides 1 hour post mortem dimensions a, b and c decrease during chilling for 24 hours /D_{13-24}/ but this decrease is not very significant. Increase of these dimensions /the length/ during thawing is also not significant. In the same way the width, i.e. dimension d is increased after the removal of hams 1 hour pos mortem and after chilling for 24 hours, but after thawing it is again decreased. These changes are not statistically significant. /Table 1b/.

Dimensions of ham, shoulder and loin after removal from the right sides and after freezing, storage and thawing. Table 1b.

Basical cuts	Samples	Time of measurement after: Removal /1h p.m./ a	b	c^+, d^x	Cooling and removal /24h p.m./ a	b	c^+, d^x	Storage of frozen cuts a	b	c^+, d^x	Thawing a	b	c^+, d^x
Ham	D_{1-12}	-	-	-	52,7	42,5	$31,2^x$	52,7	42,3	$30,9^x$	52,7	42,3	$31,6^x$
	D_{13-24}	49,5	39,7	$29,2^x$	48,4	38,6	$29,9^x$	48,4	38,4	$29,9^x$	49,4	39,2	$29,2^x$
Shoulder	D_{1-12}	-	-	-	48,5	28,9	-	48,3	27,9	-	48,7	28,3	-
	D_{13-24}	48,5	28,8	-	48,2	27,8	-	48,2	27,4	-	48,o	28,3	-
Loin	D_{1-12}	-	-	-	61,o	6o,7	$6,2^+$	61,o	6o,5	$6,2^+$	61,o	6o,7	$6,4^+$
	D_{13-24}	6o,7	59,o	$6,2^+$	6o,7	58,9	$6,2^+$	6o,7	58,9	6,2+	60,7	59,7	$6,2^+$

These changes in the dimensions of the cuts taken from the left sides are due to the development of cold shortening, but they are not strongly expressed because they appear soon post mortem, as ATP is quickly diluted. Namely, only in 8 from 24 samples of m. adductor taken from the left hams /L_{1-24}/ ATD was found only in traces, but in muscles taken from the right hams /D_{1-24}/ it was not detected.

Dimensions a and b, i.e. the length and the width of shoulders in the I group /L_{1-12}/ do not shorten significantly during freezing, but in samples of the II group /L_{13-24}/ they are significantly decreased.

Dimension a /the length/ in rights shoulders /D_{1-24}/ does not significantly change in the course of the removal and freezing, but dimension b /the width/ in samples removed 1 hour and frozen 24 hours post mortem /D_{13-24}/ is significantly shortened /$P < 0,05$/. This dimension is increased by thawing, but never reach the initial value. This increase of the dimension b is not statistically significant /Table 1b/.

Dimension a does not change in loins /that is the length of backbone in a piece/, but the length and the height of muscles /dimension b and c / change, although not very significantly /Table 1 a and b/. Four rib neck bone, shoulder and ribs with fat either do not change their shape during these treatments, or the changes are very poorly expressed.

However, in some single pieces of hams and shoulders, and especially in loins taken from the left sides /L_{1-24}/ these described changes in dimensions are not expressed.

The parts of the left sides /L_{1-24}/ release remarkably greater quantity of juice /$P < 0,01$/ during thawing than the parts of the right sides /D_{1-24}/. However, the total loss of weight during storage of the frozen pieces and during thawing /L_{13-24}/, i.e. during chilling, cold storage and thawing /D_{13-24}/ is somewhat less in the left parts

than in the right ones, but these differences are not significant. The reason is that the right sides loose their weight during chilling, i.e. during storage.

pH of m. adductor, measured 1 hour post mortem, was almost the same /6,39-6,43/ in all examined groups /L_{1-24} and D_{13-24}/. However, pH of the thawed muscles /5,56/ is significantly higher /P 0,01/ in the samples taken from the left sides in the I group /L_{1-12}/ than in the samples taken from the right sides in tha same group /5,43/ /D_{1-12}/. These was not found in the samples of the II group /L_{13-24} and D_{13-24}/.

Colour of m. long. dorsi was lighter than colour of m m. adductor and serratus ventralis. Colour of the same muscles measured 1 hour post mortem in the left /L_{1-24}/ and the right /D_{13-24}/ cuts was very similar.

However, it has been found that the colour of all three examined muscles after thawing was significantly darker /P 001/ in the muscles taken from the left sides /L_{1-24}/, i.e. in those frozen 2 hours post mortem, than the colour of muscles frozen 24 hours post mortem /D_{1-24}/./Colour of m. adductor in samples of L_{1-12} was 77,4 and of D_{1-12} was 6o,4./. It is interesting that the colour of the thawed muscles, which had been frozen 2 hours post mortem /L_{1-24}/ was darker on a surface than inside the muscles, but in those frozen 24 hours post mortem /D_{1-24}/ it was vice versa.

However, these phenomena is statistically significant in m. adductor in both groups of the left sides /L_{1-24}/, but in mm. long. dorsi and serratus ventralis only in the II group /L_{13-24}/. In pieces taken from the right sides the colour on the fresh cut was significantly darker than the one on the surface of m. long dorsi in the II group /D_{13-24}/.

The results of investigations of the cooked samples of m. long. dorsi show that the difference in the cooking loss in muscles taken from the left sides /L_{1-24}/, as well as in those taken from the right ones /D_{1-24}/ was not statistically expressed.

There is also no significant differences in softness and juiceness measured by Warner-Bratzler shear press between the samples taken from the left and from the right sides. Analyzing statistically the results of sensory evaluation of the cooked samples it has not been found significant differences between the samples of the left and of the right sides /Table 2/.

Coo-king losa, tenderness and softeness and juiciness of cooked m.long.dorsi frozen 2 and 24 h post mortem — Table 2.

Samples	Cooking loss/%/	Tendern. /W.Bratz./	Sensoric evaluat. Softn.	Juicin.	Samples	Cooking loss/%/	Tendern. /W.Bratz./	Sensoric evaluat. Softn.	Juicin.
L_{1-12}	36,7	8,13	5,2	5,5	D_{1-12}	37,2	7,88	5,1	5,6
L_{13-24}	36,5	9,24	5,7	5,7	D_{13-24}	36,4	8,7o	5,4	5,4

Summarizing average results of these investigations it can be seen that big muscles of the front and back legs in pigs shorten during quick chilling early post mortem /L_{1-24}/, although in some samples this phenomena has not been found. In most cases there were detected changes in length of hams taken from the left sides /L_{1-24}/.

By cooking of the left /L_{1-24}/ and of the right /D_{1-24}/ samples of m. long dorsi there were not found significant differences in the softness and juiciness of muscles. These results are in coincidence with tha statements from literature that cold shortening in pigs is poorly expressed /5,8/ and that these changes do not influence the quality of meat /1.3./.

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