HAM QUALITY AND ITS RELATIONSHIPS TO CARCASS QUALITY

II. Spesific weight and dissection analysis of the ham

UNTO UUSISALMI

Department of Animal Breeding, University of Helsinki

Received January 28, 1971

Abstract. Ham quality and its relationship to carcass quality were investigated in Landrace and Yorkshire pigs at the Puistola (n = 97) and Pohjanmaa (n = 103) litter testing stations by means of specific weight of the ham and dissection analysis of the ham and the most valuable part of the carcass.

The material was processed by means of factor analysis. The greatest loading in the first factor was acquired by the fat-% of the ham (0.93), the second greatest by the meat-% of the ham (—0.90), the third greatest by the skin + fat part of the ham (0.89), and the fourth by the percentage of the skin + fat component of the most valuable part of the carcass (0.82).

The skin + fat part of the ham correlated very significantly with the skin + fat component of the most valuable part of the carcass (Puistola r = 0.76, Pohjanmaa r = 0.74), and meat + bone part of the ham with the meat + bone component of the most valuable part of the carcass (Puistola r = 0.83, Pohjanmaa r = 0.81).

In the Pohjanmaa material (n = 99) the phenotypical and genotypical correlations of the ham, back and their components with the carcass and its equivalent components were found to be relatively uniform. The only exception was the correlation of the meat + bone of the ham with the meat + bone of the most valuable part of the carcass ($r_{phen.} = 0.83$, $r_{gen.} =$ 0.48).

No significant phenotypical or genotypical correlation was found between the skin + fat of the ham and meat + bone of the ham.

The object of the present study is (1) to analyse the slaughter quality of the ham by means of specific weight and dissection analysis, and (2) to compare the dissection results of the ham and of the most valuable part of the carcass.

Material and statistical method

Data were collected on 200 carcasses of Landrace and Yorkshire pigs reared to 90 kg live weight at the Puistola (n = 97) and Pohjanmaa (n = 103) litter testing stations.

Conventional carcass evaluation was made on day after slaughter. The left half of the carcass was cut and dissected in the manner presented by UUSISALMI (1969 a). The specific weights of the ham and the shoulder were determined, these were then dissected to separate the various tissues: skin, fat, meat and bones.

During the measurements carried out at the Pohjanmaa testing station, the feed was changed from barley, maize and skim milk to standard mixture.

Factor analysis was used to clarify the relationships between the dissection results on the ham and the most valuable part of the carcass and its skin + fat component and meat + bone component (n = 200). Factorisation was done from the correlation matrix (VAHERVUO & AHMAVAARA 1958 and HARMAN 1960) of the phenotype, and the rotation by the Varimax method (HARMAN 1960). In Finland factor analysis in the formation of groups of characteristics has been used by VARO on horses (1962 and 1966), pigs (1965) and sheep (1968) and by MAIJALA (1966) on poultry.

The phenotypical and genotypical correlation of the skin + fat component and meat + bone part of the ham and the back to the respective components obtained from the dissection results of the most valuable part of the carcass were determined (Pohjanmaa, n = 99); results obtained included $r_{phen.}$ = the phenotypical correlation coefficient calculated from the total variation, $r_{gen.}$ = the genotypical correlation coefficient calculated from the genetic variation, and $r_{res.}$ = the pheotypical correlation coefficient calculated from the error variation.

Results

F a c t o r a n a l y s i s (Puistola and Pohjanmaa, n = 200). The means, standard deviations and variation coefficients of certain dissection results on the ham and the most valuable part of the carcass, and of the specific weight of the ham that were included in the factor analysis, are shown in Table 1. The phenotypical correlations of the same characteristics are shown in Table 2. Of the 30 characteristics included, 2 characteristics had to be eliminated on account of a systematic error in the cards. The »error factor», a seventh factor formed on account of an error, was likewise omitted from the results of the factor analysis. Both eliminated characteristics acquired the greatest loadings in the eliminated factor. The other six factors formed after rotation, and their loadings, can be seen in Table 3 and Fig. 1.

The first factor (Fig. 1) shows that it generally measures the fattiness and meatiness of the ham and the most valuable part of the carcass. The greatest loading in this factor was acquired by the fat-% of the ham (0.93), and the second greatest by the meat-% of the ham. The factor measures third best the skin + fat component of the ham, and fourth best the percentage of the skin + fat component of the most valuable part of the carcass. It may also be mentioned that the specific weight ranhed as low as eighth with the loading —0.62.

The second factor measures the quantity and percentage of bone of the ham and the shank. The hind shank, with its second biggest loading (0.99), proves a good indicator of the amount of bone in the ham + shank.

The weight of the ham + shank and its meat + bone part acquire the greatest loading in the third factor. The fourth greatest loadings are acquired by the meat + bone of the most valuable part of the carcass and the most valuable part of the carcass (0.69).

The fourth factor is measuring the quantity of skin of the ham and the shank.

Table 1. Averages, standard deviations and varition coefficients of dissection results at the litter testing stations of Puistola and Pohjanmaa. n = 200

	Characteristics	Puistola station			Pohjanmaa station			Total material		
		$\bar{x}$	δ	variat.%	$\bar{x}$	δ	variat.%	$\bar{x}$	δ	variat. %
1	Live weight	90.41	1.88	2.07	89.32	2.55	2.85	89.85	2.31	2.57
2	Age days	167.20	8.49	5.07	178.99	12.84	7.17	173.27	12.42	7.16
3	Skin % of ham	3.86	0.55	14.24	4.25	0.63	14.82	4.06	0.62	15.27
4	Fat % of ham	16.56	2.60	15.70	17.25	2.45	14.20	16.92	2.54	15.01
5	Skin of ham + shank, g	323	44	13.62	349	52	14.90	336	50	14.88
6	Fat of ham + shank, g	1169	187	16.00	1231	342	27.78	1201	279	23.23
7	Fat % of ham + shank	16.17	2.47	15.27	17.57	6.92	39.38	16.89	5.29	31.32
8	Skin + fat of shoulder, g	883	140	15.86	935	189	20.21	910	176	19.34
9	Skin + fat of ham, g	1295	177	13.67	1346	179	13.30	1322	183	13.84
10	Skin + fat of the most valuable part, g	5668	696	12.28	5638	654	11.60	5652	673	11.91
11	Skin + fat component, % of carcass	16.75	1.98	11.82	17.11	1.74	10.16	16.94	1.86	10.97
12	Meat % of ham	72.39	2.60	3.59	71.49	2.43	3.39	71.93	2.55	3.54
13	Specific weight of ham	1.059	0.004	—	1.054	0.005	—	1.056	0.005	—
14	Meat of hind shank, g	314	30	9.55	299	35	11.71	306	34	11.11
15	Meat of ham + shank, g	4958	347	7.00	4776	383	8.01	4864	366	7.53
16	Meat % of ham + shank	68.51	2.47	3.60	67.59	2.74	4.05	68.04	2.64	3.88
17	Meat + bone of shoulder, g	2943	230	7.82	3185	266	8.35	3068	279	9.09
18	Meat + bone of ham, g	5115	352	6.88	4942	341	6.90	5206	355	6.82
19	Meat + bone of the most valuable part, g	15210	874	5.75	15545	964	6.20	15383	934	6.07
20	Meat + bone component, % of carcass	44.98	2.08	4.62	47.19	1.89	4.00	46.12	2.27	4.92
21	Bone % of ham	7.53	0.58	7.70	7.14	0.66	9.24	7.33	0.65	8.86
22	Bone of hind shank, g	325	27	8.31	322	28	8.70	323	28	8.67
23	Bone of ham + shank, g	808	61	7.55	696	76	10.92	750	55	7.33
24	Bone % of ham + shank	11.18	0.84	7.51	11.62	0.77	6.62	11.41	0.79	6.92
25	Hind shank, g	821	63	7.67	892	75	8.41	858	52	6.18
26	Ham + shank, g	7233	387	5.35	7109	400	5.63	7169	398	5.55
27	The most valuable part, g	20878	853	4.09	21182	1126	5.23	21035	1012	4.81
28	The most valuable part, % of carcass	61.73	1.34	2.17	64.30	1.32	2.05	63.06	1.85	2.93

The fifth factor is a factor measuring the skin + fat part and meat + bone part of the shoulder (shoulder factor). However, this factor also reveals the significance of shoulder as addition to the most valuable part of the carcass.

Phenotypical and genotypical correlations (Pohjanmaa, n = 99). Table 4 shows the phenotypical and genotypical correlations of ham and back and their skin + fat and meat + bone parts with the most valuable part of the carcass and its skin + fat and meat + bone components. The correlation coefficients calculated from the total variation varied from 0.66 to 0.83, and the genetic correlation coefficients calculated from the variation between sires from 0.48 to 0.89. It may be pointed out that the

Table 2. The correlation coefficients of the dissection data (n = 200) (—0.09 = — 09; 0.49 = 49). Cf. the factor analysis.

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
1	—09	—06	08	05	07	—04	16	21	37	14	08	14	20	30	—06	14	28	26	—27	02	20	10	—07	—05	39	49	—20	1
2		—04	01	—06	01	01	14	00	—03	—01	01	—33	—11	—04	—03	37	—06	14	23	—19	—05	—01	—04	—01	—05	10	27	2
3			13	86	02	04	06	23	15	24	—39	—06	—08	—32	—39	—03	—35	—14	—02	10	08	02	00	—01	—18	—03	22	3
4				11	62	48	38	90	74	80	—93	—59	—24	—44	—78	—34	—47	—49	—59	—40	—40	—08	—03	01	—04	04	08	4
5					28	25	—02	35	18	18	—29	—04	17	—10	—19	—02	—02	05	04	—05	14	—22	23	28	19	05	23	5
6						95	20	68	46	45	—51	—42	—06	—34	—11	—19	—03	—13	—26	—45	—27	—78	70	76	25	18	13	6
7							15	47	31	34	—41	—36	—12	—51	02	—18	—15	—19	—20	—34	—27	—91	85	88	03	03	10	7
8								31	60	59	—39	—46	—13	—23	—38	31	—26	—18	—36	—10	—20	02	—07	—04	—10	24	15	8
9									74	71	—82	—50	—08	—13	—65	—23	—12	—21	—44	—50	—26	—11	—00	07	34	30	18	9
10										94	—68	—46	—10	—18	—58	—14	—23	—23	—62	—34	—28	—00	—10	—04	13	44	19	10
11											—77	—55	—21	—41	—67	—23	—47	—48	—62	—40	—42	—03	—08	—04	—12	18	25	11
12												52	25	57	89	31	61	54	59	14	24	02	03	02	18	05	—05	12
13													19	35	44	—03	37	30	23	45	39	15	—02	—09	11	—03	—29	13
14														45	23	01	41	23	05	10	26	05	—01	08	45	15	—15	14
15															42	26	90	66	34	—11	29	39	—38	—31	80	49	01	15
16																22	63	51	54	—02	11	—40	43	42	24	09	—01	16
17																	28	59	54	06	24	07	—03	—03	17	45	43	17
18																		74	41	—12	34	—02	05	11	88	53	03	18
19																			72	—05	43	01	04	07	60	76	40	19
20																				—04	27	—06	09	08	17	25	61	20
21																					57	25	—02	—14	—29	—28	—40	21
22																						19	02	—02	26	21	—09	22
22																							—97	—98	—02	00	—10	23
23																								98	01	—02	02	24
24																									11	04	06	25
25																										64	09	26
26																											49	27
27																												

r > 0.14 signif. at 5 % level
r > 0.19 signif. at 1 % level
r > 0.24 signif. at 0.1 % level

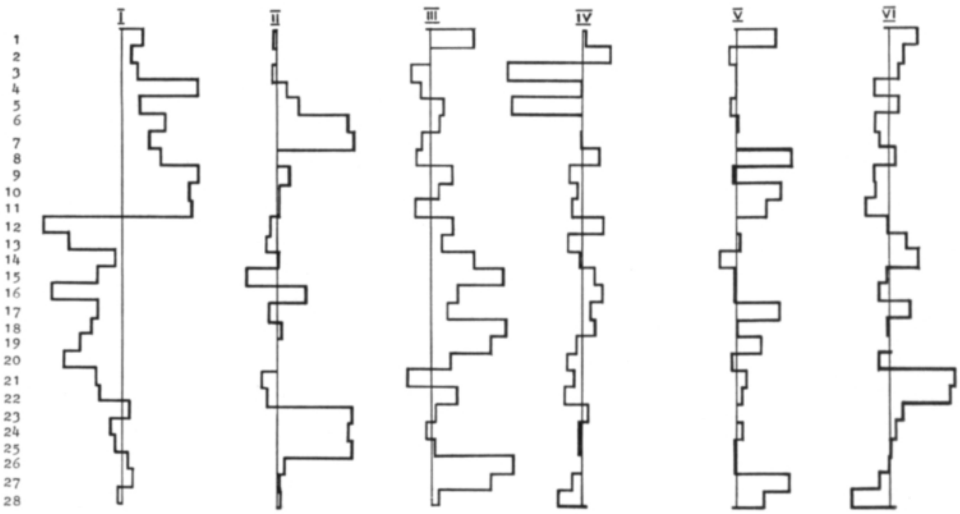

Fig. 1. Dissection results in the six factors.

1 Live weight
2 Live weight
3 Skin % of ham
4 Fat % of ham
5 Skin of ham+shank, g
6 Fat of ham+shank, g
7 Fat % of ham+shank
8 Skin+fat of shoulder, g
9 Skin+fat of ham, g
10 Skin+fat of most valuable part, g
11 Skin+fat component, % of carcass
12 Meat % of ham
13 Specific weight of ham
14 Meat of hind shank, g
15 Meat of ham+shank, g
16 Meat % of ham+shank
17 Meat+bone of shoulder, g
18 Meat+bone of ham, g
19 Meat+bone of most valuable part, g
20 Meat+bone component, % of carcass
21 Bone % of ham
22 Bone of hind shank, g
23 Bone of ham+shank, g
24 Bone % of ham+shank
25 Hind shank, g
26 Ham+shank, g
27 Most valuable part of carcass, g
28 Most valuable part, % of carcass

genotypical correlation coefficients between the dissection results on the back and the most valuable part of the carcass were slightly greater than the genotypical correlation coefficients between the dissection results on the ham and the most valuable part of the carcass.

Discussion

In the factor analysis the first joint factor was formed, measuring the fat content and the meat content of the ham, as the analysis included the percentage of fat and the percentage of meat in the ham. The result might have been different had the percentages been omitted from the analysis.

It may also be mentioned that in the first factor the specific weight came as low as eighth with the loading —0.62. At Pohjanmaa the specific weight was determined on slaughterhouse scales that could only be read to an accuracy of 20 grams. In the Puistola material the scales could be read to an accuracy of 5—10 g. For both materials, the following Table elucidates the correlation between the specific weight of the ham and the dissection results on the ham and the most valuable part of the carcass.

Table 3. The rotated loadings of the factors

		factor I	factor II	factor III	factor IV	factor V	factor VI
1	Live weight, kg	23	—03	46	04	46	30
2	Age days	09	—01	—00	31	—10	15
3	Skin % of ham	18	—04	—21	—89	—01	11
4	Fat % of ham	93	12	—12	—02	—02	—19
5	Skin of ham + shank	18	22	15	—86	—07	10
6	Fat of ham + shank, g	52	82	13	—02	—01	—16
7	Fat % of ham + shank	34	92	—08	—03	—00	—13
8	Skin + fat of shoulder, g	47	00	—17	17	64	05
9	Skin + fat of ham, g	89	15	25	—19	—02	—20
10	Skin + fat of most valuable part of carcass, g	80	03	08	—08	49	—19
11	Skin + fat of most valuable part, % of carcass	82	03	—19	—12	35	—28
12	Meat % of ham	—90	—07	27	24	00	—03
13	Specific weight of ham	—62	—14	17	—19	02	19
14	Meat of hind shank	—06	01	54	—04	—21	31
15	Meat of ham + shank	—30	—37	85	12	—00	—06
16	Meat % of ham + shank	—82	35	29	22	00	—13
17	Meat + bone of shoulder, g	—31	—07	20	08	50	20
18	Meat + bone of ham, g	—39	05	88	11	02	—04
19	Meat + bone of most valuable part of carcass, g	—48	00	69	—08	29	02
20	Meat + bone of most valuable part, % of carcass	—70	—00	23	—17	—05	—15
21	Bone % of ham	—32	—17	—28	—11	09	74
22	Bone of hind shank, g	—28	—09	31	—22	06	70
23	Bone of ham + shank, g	06	99	06	02	01	13
24	Bone % of ham + shank	—15	98	—06	—06	02	08
25	Hind shank, g	—09	99	04	—06	—01	03
26	Ham + shank, g	07	08	97	—01	—01	—03
27	Most valuable part of carcass, g	09	02	69	—12	59	—11
28	Most valuable part, % of carcass	—04	03	10	—32	29	—46

Table 4. Phenotypical and genotypical correlations of ham, back and their skin + fat and meat + bone parts with the most valuable part of the carcass and its components (99 pigs from the Pohjanmaa testing station in 1967—68).

X correlated with Y	$r_{phen.}$	$r_{gen.}$	$r_{res.}$
Ham — most valuable part of carcass	0.67	0.62	0.68
Back — most valuable part of carcass	0.67	0.76	0.65
Skin + fat of ham — skin + fat of the most valuable part	0.72	0.79	0.70
Skin + fat of back — skin + fat of the most valuable part	0.76	0.89	0.72
Meat + bone of ham — meat + bone of the most valuable part	0.83	0.48	0.99
Meat + bone of back — meat + bone of the most valuable part	0.66	0.52	0.69
Skin + fat of ham — meat + bone of ham	—0.14	—0.00	—0.23
Skin + fat of back — meat + bone of back	0.06	0.04	0.07
Skin + fat component (of carcass) — meat + bone component (of carcass)	0.06	0.14	0.11

	Ham		Most valuable part of the carcass		
	skin + fat	meat + bone	skin + fat	meat + bone	
	Y_1	Y_2	Y_3	Y_4	
Specific weight	—0.79	0.33	—0.72	0.55	Puistola
of the ham (X)	—0.27	0.28	—0.37	0.34	Pohjanmaa
	—0.50	0.37	—0.46	0.30	Total

The Table 1 shows that the accuracy of the scales at Pohjanmaa was not sufficient for the determination of the specific weights. The Puistola material established the great importance of the specific weight, of ham for measurement of the skin + fat part of the ham and skin + fat component of the most valuable part of the carcass.

Owing to the testing technique there occurs a so-called auto-correlation in the results of the factor analysis as well as in other results of the dissection analysis based on correlation computations. This hardly reduces the serviceability of the results in breeding work, however.

At the present stage of breeding there is no correlation worth mentioning between the skin + fat part of the ham and the meat + bone part of the ham (Puistola, r = —0.18, Pohjanmaa, r = —0.00). Thus a decrease in the amount of fat in the ham does not necessarily imply a corresponding increase in the meat + bone part. Consequently, the present sudy aimed at measuring not only the fattiness of the ham but also the weight of its meat + bone component. This can be done because it is easy to detach the ham comparably from the carcass, and the ham can easily be separated into its skin + fat and meat + bone parts. The sales value of the carcass declines somewhat with this treatment. The cutting of the ham into two parts can also be advocated on the grounds that a knowledge of the skin + fat part of the ham provides rather a lot of information on the skin + fat component of the most valuable part of the carcass (Puistola, r = 0.76, Pohjanmaa, r = 0.74) and, similarly, the meat + bone part of the ham correlates very significantly with the meat + bone component of the most valuable part (Puistola, r = 0.83, Pohjanmaa, r = 0.81). It may be mentioned that according to Blendl (1966) a ham stripped of its fat correlated very significantly with the total quantity of meat obtained by complete dissection of the carcass; n = 116, r = 0.86.

The respective phenotypical and genotypical correlation coefficients (Table 4) were generally of the same order of magnitude. An exception is the correlation of the meat + bone part of the ham with the meat + bone component of the most valuable part of the half carcass. ($r_{phen.} = 0.83$ and $r_{gen.} = 0.48$). However, in this case too the genotypical correlation is held to be so high that the meat + bone component of the most valuable part of the carcass can be positively influenced by selecting for a large meat + bone part of the ham.

REFERENCES

Blendl, H. M. 1966. Objektive Methoden zur Bestimmung des Schlachtkörperwertes beim Schwein als Hilfsmittel für die züchterische Selektion. Z-kunde 38: 234—246.

Harman, H. H. 1960. Modern faktor analysis. 469 p. Chicago.

Maijala, K. 1966. Repeatabilities and correlations of economic traits in the Finnish Random Sample egg-laying Test. Ann. Agr. Fenn. 5: 48—63.

Uusisalmi, U. 1969 a. Vorläufige Ergebnisse über das Messen der Schlachteigenschaften beim Schwein. J. Sci. Agr. Soc. Finland 41: 50—59.

—»— 1969 b. Carcass analysis as aid in pig breeding. Acta Agric. Scand. 19: 214—220.

—»— 1971. Inheritance in ham and its components in Finnish Landrace and Yorkshire breeds. Acta Agr. Scand. 21: 73—83.

Vahervuo, T. & Ahmavaara, Y. 1958. Johdatus faktorianalyysiin. WSOY, Helsinki.

Varo, M. 1962. Über die Begrenzung der Beurteilungseigenschaften bei der Eberauslese. Ergebnis der Faktorenanalyse. Ann. Agr. Fenn. 1: 267—283.

—»— 1965. Einige Beobachtungen über Anwendungsmöglichkeiten von Ergebnissen der Faktorenanalyse. Ibid. 4: 91—95.

—»— 1966. Über den Zusammenhang der bei Pferden zu züchtenden Züge. Ibid. 5: 100—113.

—»— 1968. Lampaiden kasvatuskokeiden tuloksia. Summary: Results of rearing trials with Finnish sheep. Ibid. 7: 33—45.

SELOSTUS

KINKUN TEURASLAATU JA SEN YHTEYS RUHON TEURASLAATUUN

II. KINKUN OMINAISPAINO JA LEIKKELYANALYYSI

Unto Uusisalmi

Helsingin Yliopisto, Kotieläinten jalostustieteen laitos

Kinkun teuraslaatua ja sen yhteyttä ruhon laatuun tutkittiin maatiais- ja yorkshirerotuisista kantakoesioista Puistolan ja Pohjanmaan koeasemilla vuosina 1967—68.

Perinteellisen teurasarvostelun jälkeen ruhon puolisko paloiteltiin ja sen arvokkain osa leikattiin nahka + rasva- ja liha + luu-komponenteiksi. Kinkun ominaispainon määrittämisen jälkeen se leikattiin kudososiinsa: nahka, rasva, liha ja luut.

Materiaalia (n = 200) käsiteltiin faktorianalyysin avulla. Ensimmäisessä faktorissa esiintyivät suurimmilla latauksilla kinkun rasva-% (0.93), kinkun liha-% (—0.90), kinkun nahka + rasvan paino (0.89) ja ruhon arvokkaimman osan nahka + rasvan %-osuus (0.82). Lisäksi todettiin, että kinkun nahka + rasva korreloitui erittäin merkitsevästi ruhon arvokkaimman osan nahka + rasvaan (Puistola, r = 0.76, Pohjanmaa, r = 0.74) ja kinkun liha + luu ruhon arvokkaimman osan liha + luuhun (Puistola, r = 0.83, Pohjanmaa, r = 0.81). Kinkun nahka + rasvan ja liha + luun välillä ei todettu merkittävää korreloitumista.

Pohjanmaan materiaalilla (n = 99) todettiin kinkun ja kyljysselän sekä niiden komponenttien fenotyyppinen ja genotyyppinen korreloituminen ruhon arvokkaimpaan osaan ja sen komponentteihin verrattain yhdenmukaiseksi. Poikkeuksen tästä muodosti kinkun liha + luun korreloituminen ruhon arvokkaimman osan liha + luu-komponenttiin ($r_{phen.} = 0.83$, $r_{gen.} = 0.48$).