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Chemical and Physical Characteristics of *Longissimus Dorsi* Muscle of Baladi Cattle and Twelve of Their Crossbreds(1)

A.A. Nigm, M.A.I. Salem, N.M. Abdallah and A.K. El Asheeri

Animal Breeding Dept. and Food Sci. and Tech. Dept. Faculty of Agriculture, Cairo University.

MEAT samples from **longissimus dorsi** muscle were taken from 80 males slaughtered at 18 months of age and representing 13 cattle genotypes. The genotypes included Egyptian Baladis and their eight half-breds with Red Angler, Braunvieh, Deutsches Braunvieh, Grauvieh, Friesian, Fleckvieh, Gelbvieh and Pinzgauer in addition to the three quarter-breds of the Red Angler, Braunvieh, Grauvieh and Friesian.

Both chemical and physical characteristics of meat samples were determined. Least squares means of the above mentioned genotypes were 74.4, 74.7, 74.6, 74.5, 73.9, 75.1, 74.9, 74.3, 75.4, 74.5, 74.6, 75.6 and 76.1 for % moisture; 1.96, 0.97, 1.25, 1.05, 1.49, 1.24, 0.93, 1.06, 0.96, 0.79, 1.39, 0.57 and 0.61 for % intramuscular fat ; 22.6, 23.3, 23.1, 23.4, 23.4, 22.7, 23.2, 23.7, 22.8, 23.7, 23.0, 22.8 and 22.2 for % protein and 1.00, 0.99, 1.07, 1.06, 1.11, 1.04, 0.98, 0.96, 0.89, 1.00, 1.01, 1.01 and 1.03 for % ash.

The corresponding means for physical characteristics were 6.84, 6.71, 7.55, 6.74, 4.14, 7.44, 8.30, 8.18, 6.40, 7.30, 7.57, 8.08 and 7.35 for Warner Bratzler Shear ; 36.9, 36.4, 36.7, 85.5, 37.3, 36.1, 35.3, 38.2, 36.0, 34.9, 33.3, 37.3 and 37.9 micron for fiber diameter ; 32.8, 35.8, 34.5, 34.7, 33.1, 32.4, 31.8, 31.5, 35.5, 32.0, 36.1, 34.3 and 37.2 for % expressible fluid and 5.58, 5.67, 5.66, 5.62, 5.66, 5.63, 5.64, 5.67, 5.62, 5.63, 5.7, 5.61 and 5.61 for pH value.

Genotypic differences were statistically significant only in % intramuscular fat (at the 1% level), Warner Bratzler Shear force and pH value (at the 5% level). Correlation coefficients among chemical and physical characteristics were also determined and tested.

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Meat quality characteristics measured by chemical and physical analyses are exact methods used for estimating the economic value of beef carcass. The information obtained from such analyses could also be of great help to the breeder for selecting his breeding stock and drawing his breeding programmes.

The selection of the breed or breeds for crossing purposes should be based on precise evaluation of the different crosses and grades with respect to the different aspects of fertility, mortality and milk and meat potentialities. The evaluation should better be done on a wide range of genetic resources, testing dairy, dual purpose and beef breeds for crossing and grading up purposes.

With respect to beef production, the studies of Mostageer *et al.* (1982), Rashad (1982) and Ibrahim (1984) confirmed the advantages of crossbreeding in increasing meat output.

The main objective of this study is to evaluate the quality characteristics of the meat of Baladi cattle and their crossbreds and the interrelationships among different chemical and physical characteristics.

Material and Methods

Data were collected on a sample of the offspring produced by a crossbreeding project in South Tahreer Province, Egypt during the years 1977 and 1978.

Frozen semen from eight European breeds, namely, the Red Angler (RA), Brauvieh (BV), Deutsches Braunvieh (DBV = BV × Brown Swiss), Grauvieh (GV), Friesian (FR), Fleckvieh (FV), Pinzgauer (PG) and Gelvieh (GlbV) ; and fresh semen from Baladi bulls were used to inseminate a herd of the Baladi cows to produce the pure Baladi (BAL) and the eight halfbreds. The halfbred heifers of the RA, BV, GV, and FR were backcrossed to the respective foreign breed to produce the three quarter breds.

Management of the breeding herd was described in detail by Mostageer *et al.* (1982). Eighty male calves were randonly chosen and slaughtered at the fixed age of 18 months. Numbers of bulls distributed by genotype and month of birth are shown in Table 1.

Table(1)

Numbers of nimals distributed according to genotype and month of birth

Month of Birth	Genotype													
	BAL	$\frac{1}{2}$RA	$\frac{1}{2}$BV	$\frac{1}{2}$DBV	$\frac{1}{2}$GV	$\frac{1}{2}$FR	$\frac{1}{2}$FV	$\frac{1}{2}$GlbV	$\frac{1}{2}$PG	$\frac{3}{4}$RA	$\frac{3}{4}$BV	$\frac{3}{4}$GV	$\frac{3}{4}$FR	Total
October-Feb.	2	3	1	4	1	1	2	4	0	0	2	0	0	20
March	2	1	1	1	2	3	3	1	1	2	0	0	1	18
April	1	2	2	1	5	2	1	3	2	0	1	1	0	21
May-August	1	0	1	2	3	3	1	1	2	2	1	2	2	21
Total	6	6	5	8	11	9	7	9	5	4	4	3	3	80

Animals were fasted for 18 hr before slaughtering and the left side of each carcass was chilled for 24 hr at 5°C. The longissimus dorsi muscles of the *9th, 10th* and *11th* ribs were taken after chilling and used for chemical and physical analyses.

Chemical and Physical Analyses

Moisture, fat and ash percentages were determined according to A.O.A.C. methods (1975). The protein percentage was estimated as recommended by O'Mary *et al.* (1979).

One sample of cooked meat per animal was taken to determine tenderness by using Warner-Bratzler Shear (WBS) machine (capacity 50 × 1 lb.) as described by Gravert (1965).

Three cubes of 1 × 1 × 2 cm. were cut from *Longissimus dorsi* muscle and placed in 10% formalin. Before measuring fiber liameter (FD) samples were put on 20% nitric acid for five days, then washed and put in a watch glass with a buffer of glycerol and distilled water. Fifty fibers per animal were selected randomly to be measured according to the technique described by Gravert (1965).

For estimating cooking loss (CL), a sample of 100 to 200 grams was weighed and put in boiling water for 45 min. The sample was removed from water and left to reach room temperature, then reweighed to calculate the cooking loss as a percentage from the initial weight.

Expressible fluid (EF) was determined by weighing about 0.3 gram and put on filter paper under pressure of one kilogram for 10 min then weighed again. The expressible fluid was estimated as the difference in weight taken as a percentage from the initial weight. pH value was determined in the meat samples by using Bechman-PH-meter.

Statistical Analysis of Data

The data were analysed by least squares analysis of variance (Harvey, 1960). Differences between means were tested using Duncan's Multiple Range Test (Duncan, 1955).

The main effects used for each trait were the genotype and the month of birth (classes are shown in Table 1).

Simple correlation coefficients among chemical and physical characteristics were computed.

Results and Discussion

1. *Chemical composition*

Least squares means and standard errors of chemical composition characteristics are shown in Table 2. The corresponding analysis of variance is given in Table 3.

Genotypic differences in percentage of moisture were insignificant. However, it can be seen from Table 2 that the FR crosses scored the highest percentage of moisture, *i.e.* the lowest percentage of dry matter, compared with their corresponding groups having the same percentage of foreign blood. The results obtained here agree with those of Nigm *et al.* (1983) who reported that ½ GV crossbreds showed the highest dry matter percentage among the Baladi and some of its crosses used in this study.

Intramuscular fat percentage of the *longissimus dorsi* muscle showed highly significant genotypic differences (Table 3). The Baladi scored the highest percentage (1.96) and was statistically different from all means of crossbred groups (except for ½ GV and 3/4 scoring 1.49 and 1.39%, respectively). Nigm *et al.* (1983)

reported comparable results. The pure Baladi had 3.39% fat in *longissimus dorsi* muscle which was significantly higher than those of FR, RA, GV and BV halfbreds (1.22, 2.10, 1.76 and 1.54%, respectively).

Table (2) : Means(1) (+ (± SE) of moisture, intramuscular fat, protein and ash percentages.

Classification	N	% moisture $\bar{x}$	SE	% Fat $\bar{x}$	SE	% Protein $\bar{x}$	SE	% Ash $\bar{x}$	SE
Genotype:									
BAL	6	74.4^{ab}	.50	1.96^{a}	.19	22.6^{a}	.47	1.00^{ab}	.07
½RA	6	74.8^{ab}	.51	0.97^{bc}	.17	23.3^{a}	.48	0.99^{ab}	.07
½BV	5	74.6^{ab}	.55	1.25^{bc}	.21	23.1^{a}	.51	1.07^{ab}	.07
½DBV	8	74.6^{ab}	.44	1.05^{bc}	.17	23.4^{a}	.41	1.06^{ab}	.06
½GV	11	74.0^{a}	.38	1.49^{ac}	.14	23.4^{a}	.35	1.11^{a}	.05
½FR	9	75.1^{ab}	.4[illegible]	1.24^{b}	.16	22.7^{a}	.38	1.04^{ab}	.06
½FV	7	74.9^{ab}	.47	0.93^{b}	.18	23.2^{a}	.43	0.98^{ab}	.06
½GrbV	9	74.3^{ab}	.42	1.06^{b}	.16	23.7^{a}	.39	0.96^{ab}	.06
½PG	5	75.4^{ab}	.55	0.96^{b}	.21	22.8^{a}	.52	0.89^{b}	.08
¾RA	4	74.5^{ab}	.63	0.79^{b}	.24	23.7^{a}	.59	1.00^{ab}	.09
¾BV	4	74.6^{ab}	.62	1.39^{abc}	.24	23.0^{a}	.58	1.01^{ab}	.08
¾GV	3	75.6^{ab}	.72	0.57^{b}	.28	22.8^{a}	.67	1.01^{ab}	.10
¾FR	3	76.1^{b}	.72	0.61^{b}	.28	22.2^{a}	.67	1.03^{ab}	.10
Month of birth:									
Oct.-Feb.	20	74.9^{a}	.31	1.15^{a}	.12	22.9^{a}	.29	1.01^{ab}	.04
March	18	74.6^{a}	.31	1.04^{a}	.12	23.3^{a}	.28	1.07^{a}	.04
April	21	75.3^{a}	.29	1.05^{a}	.11	22.7^{a}	.27	0.94^{b}	.04
May-Aug.	21	74.5^{a}	.29	1.16^{a}	.11	23.3^{a}	.26	1.02^{ab}	.04

(1) Means not followed by same letter differ significantly from each other at 5% level.

With respect to the effect of proportion of foreign blood on intramuscular fat, there was a trend towards decreasing % fat with the increase in foreign blood. However, differences between halfbreds and their respective three quarterbreds were statistically insignificant.

Table (3) : Analysis of variances of moisture, fat, protein and ash percentages.

Source of variance	d.f.	Mean Squares			
		% moisture	% fat	% protein	% ash
Genotype	12	1.61 NS	0.75**	0.91 NS	0.02 NS
Month of birth	3	1.34 NS	0.14 NS	1.13 NS	0.05 NS
Residual	64	1.49	0.21	1.27	0.03

NS Not significant.
** Significant at the 1 % level.

As the comparisons were made on an age-constant basis, the statistically higher percentage of intramuscular fat in the *longissimus dorsi* muscle of Baladis suggests the early maturity of this breed. This conclusion has been confirmed by Mostageer *et al.* (1982), Rashad (1982) and Ibrahim (1984).

Differences in protein percentages exceeded more than 1% between the Baladi (22.6%) and both ½ GLbv and 3/4 RA (23.7% for both) but were statistically insignificant. Except for the 3/4 FR crosses which showed the lowest percentage (22.2%), all crossbred groups surpassed the Baladi in this respect.

2. *Physical characteristics*

Least squares means of physical characteristics are shown in Table 4 and analyses of variances of these traits are presented in Table 5. Meat tenderness is most accurately determined by measuring the force required for shearing a standard meat sample. The increase in the shear force value indicates a corresponding decrease in meat tenderness.

Genotypic differences in Warner Bratzler Shear force were significant at the 5% level. The pure Baladi group had WBS value of 6.84 significantly lower than 8.57 and 8.30 scored by 3/4 BV and 1/2 FV, respectively. The halfbred Pinzgauer produced the most tender meat and required only 6.4 WBS force.

Table (4) : Means(1) (± SE) of physical characteristics of longissimus dorsi muscle.

Classification	N	Warner Bratzler Shear (50x1lb) $\bar{x}$	SE	Fiber diameter (μ) $\bar{x}$	SE	Cooking loss (%) $\bar{x}$	SE	Expressible fluid (%) $\bar{x}$	SE	pH value $\bar{x}$	SE
Genotype:											
BAL	6	6.84 ab	0.45	36.9 ab	1.01	43.8 a	1.49	32.8 ab	1.34	5.58 a	0.03
½RA	6	6.71 a	0.46	36.4 ab	1.03	42.2 a	1.52	35.8 a	1.37	5.67 b	0.03
½BV	5	7.55 ac	0.50	36.7 ab	1.10	43.1 a	1.63	34.5 ab	1.47	5.66 ab	0.03
½DBV	8	6.74 a	0.40	35.5 ab	0.89	39.7 a	1.31	34.7 ab	1.18	5.62 ab	0.02
½GV	11	7.14 ac	0.34	37.3 a	0.76	42.8 a	1.12	33.1 ab	1.01	5.66 b	0.02
½FR	9	7.44 ac	0.37	36.1 ab	0.83	43.8 a	1.22	32.4 ab	1.10	5.63 ab	0.03
½FV	7	8.30 c	0.42	35.3 ab	0.94	41.6 a	1.39	31.8 ab	1.25	5.64 ab	0.03
½GlbV	9	8.18 bc	0.38	38.2 a	0.84	43.2 a	1.24	31.5 ab	1.12	5.57 b	0.02
½FG	5	6.40 a	0.50	36.0 ab	1.12	43.2 a	1.65	35.5 a	1.49	5.62 ab	0.03
3/4RA	4	7.30 ac	0.57	35.0 ab	1.27	41.4 a	1.87	32.0 b	1.69	5.63 ab	0.02
3/4BV	4	8.57 c	0.56	33.3 b	1.25	43.0 a	1.84	36.1 ab	1.66	5.76 c	0.03
3/4GV	3	8.08 ac	0.65	37.3 ab	1.45	43.1 a	2.15	34.3 ab	1.94	5.61 ab	0.04
3/4FR	3	7.35 ac	0.65	37.9 ab	1.46	38.4 a	2.15	37.2 ab	1.94	5.61 ab	0.06
Month of birth:											
Oct.-Feb.	20	7.16^{a}	0.28	36.7^{a}	0.62	40.0^{a}	0.92	34.8^{ab}	0.83	5.60^{a}	0.02
March	18	7.58^{a}	0.28	36.7^{a}	0.61	42.5^{ab}	0.91	35.2^{a}	0.77	5.65^{ab}	0.02
April	21	7.69^{a}	0.26	35.4^{a}	0.58	43.9^{b}	0.86	33.2^{ab}	0.77	5.65^{b}	0.02
May-Aug.	21	7.29^{a}	0.25	36.3^{a}	0.56	42.6^{b}	0.82	32.6^{b}	0.74	5.68^{b}	0.02

1 Means not followed by same letter differ significantly at the 5% level.

Table (5)

Analyses of variances[1] of physical characteristics

Source of variance	d.f.	Mean Squares: Warner Bratzler Shear	Fiber diameter	Cooking loss	Expressible fluid	PH Value
Genotype	12	2.66 *	9.10 NS	12.75 NS	17.77 NS	0.009 *
Month of birth	3	1.15 NS	6.93 NS	47.55 *	24.68 NS	0.018 *
Residual	64	1.22	6.02	13.19	10.70	0.004

* Significant at the 5% level.

There was an increase in the shear value (lower tenderness) as the percentage of foreign blood increased from 50 to 75%, however, differences between halfbreds and their respective 3/4 breds were insignificant.

Fiber diameter differences due to genotype were also, insignificant, however, the Baladi meat had a moderate diameter

(36.9 micron) where the 3/4 BV had the lowest diameter (33.3 micron) and the 1/2 GlbV scored the highest (38.2 micron). There was no obvious trend concerning the effect of the proportion of foreign blood on the diameter of *L. dorsi* fibers.

With reference to cooking loss, the pure Baladi meat and the 1/2 FR showed the maximum loss (43.8% for both), much higher than the 3/4 FR (only 38.4%). The difference of about 5.5% has its important economic meaning.

The mean of the pure Baladi meat of expressible fluid lies within the range of crossbred means. Differences were statistically insignificant. The 3/4 FR showed the highest percentage (37.2), about 5% over the pure Baladi mean. It should be noted that such differences point to the importance of repeating this work using more material for more concrete results.

Genotypic differences in pH value of meat samples from *L. dorsi* muscle were significant at the 5% level. The Baladi meat had the lowest pH value (5.58) significantly different from means of 3/4 BV, 1/2 RA, 1/2 GlbV and 1/2 GV crossbreds (5.76, 5.67 and 5.66, in respective order. There was a slight decrease in pH value as the proportion of foreign blood increased. However, the 3/4 BV crosses which had the highest pH value surpassed significantly their corresponding halfbreds in this respect.

3. *Relationships among different chemical and physical characteristics*

Assessment of the direction and magnitude of the relationships existing among different chemical and physical characteristics of meat is of utmost importance in selecting the cattle breed and developing the breeding programmes.

Table 6 shows the pooled, calculated from pooled data (above) and the within-subclass (below diagonal) coefficients of correlation among different chemical and physical characteristics. However, comparing corresponding figures of the two sets (pooled and within-subclass) reveals no marked differences in direction or significance.

Body weight at slaughter showed significant correlation with both fiber diameter and expressible fluid (within sub-class r = .245 and .293, resp.). The pooled correlation between body weight and % fat was significant at the 1% level and valued 0.369. However, when calculated within sub-class, the correlation was insignificant.

Table (6) : Pooled (above diagonal) and within-subclass (below diagonal) phenotypic coefficients of correlation among physical and chemical characteristics.

	BW	WBS	FD	CL	EF	pH	% Moisture	% Fat	% Protein	% Ash
BW	....	0.010 NS	0.328 **	-.042 NS	0.149 NS	-.059NS	-.211NS	0.369**	0.092NS	-.118NS
WBS	0.162 NS	....	-.021 NS	0.330 **	-.050 NS	0.025NS	0.098NS	-.314**	0.206NS	0.199NS
FD	0.245 *	-.069 NS	....	0.102 NS	-.146 NS	0.149NS	0.142NS	-.067NS	-.117NS	0.064NS
CL	-.155 NS	0.330 **	0.023 NS	....	-.153 NS	0.284*	-.174NS	-.242*	0.273*	0.093NS
EF	0.293 *	-.146 NS	-.109 NS	-.245 *	....	-.166NS	0.032NS	0.035NS	-.032NS	-.115NS
PH	-.015 NS	0.176 NS	-.021 NS	0.331 **	-.173 NS	....	-.145NS	-.132NS	0.200NS	-.120NS
%MOISTURE	-.086 NS	-.036 NS	0.017 NS	-.109 NS	0.091 NS	-.171NS	....	-.388**	-.918**	-.113NS
%FAT	-.044 NS	-.281 **	-.008 NS	-.056 NS	-.053 NS	-.095NS	-.388**	....	-.037NS	-.087NS
%PROTEIN	0.119 NS	0.162 NS	-.021 NS	0.149 NS	-.072 NS	0.228NS	-.872**	-.052NS	....	-.012NS
%ASH	-.024 NS	0.095 NS	0.046 NS	-.013 NS	-.012 NS	0.035NS	-.236NS	0.036NS	0.098NS	....

NS Not significant

* Significant at the 5% level.

** Significant at the 1% level.

The relationship between tenderness and fiber diameter failed to reach the level of statistical significance. Pooled and within subclass coefficiences of correlation between Warner Bratzler Shear value and fiber diameter were 0.069 and — .021, respectively. Lewis *et al.* (1977) attributed the lack of significance of the relationship between the two traits to the small range of ages of the animals used in their investigation. The same could be the reason for lack of significance in this work since comparisons were made slaughtered at 18 months of age. This explanation is supported by the known fact that the significant relationship between WBS and FD is attributed mainly to the FD animal age relationship.

Meat tenderness proved to have close relation with intramuscular fat percentage. The pooled and within sub-class coefficients of correlation were negative and significant at the 1% level scoring — .314 — .281, respectively.

In general, it could be concluded from the results obtained that crossing and grading up Egyptian Baladi cows with exotic standard breeds did not influence the nutritive value of meat. However, fat percentage was significantly lowered in crosses and grades of Baladi. Also, the differences existed between the pure Baladi meat and that of its crosses in eating quality characteristics were almost negligible and lack statistical significance. The results revealed that increasing the proportion of the foreign blood in the crossbred animals from 50% to 75% has no marked effect on the chemical and physical characteristics of meat considered in this study.

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الصفات الكيماوية والطبيعية للعضلة العينية فى الماشـــية البلدية و ١٢ من هجنها مع السلالات الاوروبية

على عطيه نجم ، محمد على ابراهيم سالم ، نادية محمد عبد الله وآمال كال العشيرى

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كلية الزراعة ـ جامعة القاهرة

درست الصفات الكيماوية والطبيعية على العضلة العينية لعدد ثمانين عجلا ذبحت عند عمر ١٨ شهرا وشملت أنواع الابقار البلدية وذكور الجيل الأول من هجنها مـع الردانجلر ، والبراونفيـه الالمانى ، والجـــراوفيه ، والفريزيان ، والفليكفيه والبنزجاور ، والهجن الرجعيـــة للنوع الاجنبى (٧٥٪ أجنبى) الناتجة من التلقيح بطلائق الردانجلر ، والبراونفيـــه ، والجراوفيه والفريزيان .

أثر التركيب الوراثى معنويا (على مستوى ١٪) على نســـبة الدهن فى العضلة العينية وكان أعلا فى البلدى من متوسط نسبة الدهن فى لحم جميع الانواع الاخرى (عدا ½٪جراوفيه ، ¾٪ براونفيه) ، كما اظهر تأثيرا معنويا (على مستوى ٥٪) على كل من قوة الشد (وارنر ـ بـــراتزلر) ورقم الحموضة .

اوضحت الدراسة ان تهجين وتدريج الابقار البلدية بالانواع المذكـورة فى هذه التجربة لم تؤثر على القيمة الغذائية أو الصفات الطبيعية للحوم .