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MEAT PRODUCTION FROM EGYPTIAN BUFFALOES

II.—Physical and Chemical Characteristics of Buffalo meat

By

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SUMMARY

Physical and chemical characteristics of buffalo meat were studied using animals previously described by Ragab *et al* (1964). The following results were obtained :

1. The percentage of fore-quarters were 51.54, 50.99, 50.45 52.96 and 52.92 at ages of 50 days, 6,12,18 and 24 months, meanwhile the percentage of hindquarters at the same ages were 47.37, 58.64, 47.71, 46.61 and 47.08 respectively.

2. The buffalo carcass was divided to the following meat cuts : top side, silver and back side, aitchbone, rump, thick flank, sir loin and 5th rip piece as high priced cuts. The hind shin, 8th rib piece, chuck, brisket, neck, fore shin and thin flank as low priced cuts. The components of each cut represented fatty, lean and bony tissues were measured. Fattening to older ages proportionally increased the percentage of low priced cuts while high priced cuts remained constant. There was significant correlation between the length of silver side, posterior length of carcass and the percentage of fat and lean in the carcass.

3. The percentage of loss due to chilling at zero C, for 24 hours was 4.71, 2.76, 2.69 2.24 and 1.89 at the ages of 50 days, 6, 12, 18 and 24 months. This means that the younger the animal the more is the loss due to chilling. It appears that chilling favours the colour and acidity of the buffalo meat.

4. The pH value in fresh meat ranged from 6.67 to 6.30 at the age of 50 days and bulls of 24 months. After chilling the reduction in the pH value was 1.34 in the former and .23 in the latter age.

5. Generally speaking, it was found that the buffalo meat is darker than that of cattle. Castration reduced the colour remarkably. Also the meat-colour in steers was lighter than in non-castrated animals.

6. (*a*) The chemical analysis of four cuts sir loin, topside, thin flank, chuck indicated that the percentage of dry matter, protein, ash and ether extract were 22.09, 17.64, 1.05, 1.25 at the age of 50 days, mean while the former percentages at age of 24 months in buffalo bulls were 23.87, 20.71, 0.81, 2.57%.

(*b*) The high priced cuts were superior in the percentage of protein and ash than low priced cuts.

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(c) Marbling scores (the ether extract of the longissimus dorsi at ribs 9, 10, 11) were higher in buffalo bulls than buffalo steers at different ages. The marbling scores at ages of 6 and 18 months were 2.97 and 4.12% respectively.

(d) Castration was found to have no effect on the chemical components of buffalo meat at the ages of 12, 18 and 24 months.

7. Measurements of longissimus dorsi at ribs 9,10, 11, 12, 13 were not a good indicator for shape index as in the case of cattle. The area of longissimus dorsi at the 13th rip was the best indicator for the shape index as it showed gradual increase with advancing age when the actual percentage of lean and fat increased. The meat bone ratio ranged from 66.81 to 75.35 for buffalo bulls and was higher in steers.

INTRODUCTION

Generally speaking, buffaloe's meat is rather inferior to that of cattle. No material evidence as to its quality was reported. In this work, physical and chemical characteristics were worked out in a group of buffalo bulls and steers at different ages.

MATERIAL AND METHODS

Animals used in this study were the same previously described by Ragab *et al* (1964).

p.H. Value Determination :

The pH value of beef in the longissimus dorsi of the 13 rib was determined using pH meter. Both electrodes were applied with a moderate amount of pressure to the lean portion. The same process was carried out after chilling.

Colour of Meat :

Colour of lean and fat was determined vissually by the naked eye.

Chemical Analysis :

Procedures as outlined by the A.O.A.C. (1960) were followed in the chemical analysis of the four cuts. Ash, fat and protein were determined in the dry matter. Ether extract represented the marbled fat.

RESULTS AND DISCUSSION

Fore and Hind-Quarters :

It is shown in (Table 1) that the percentage of fore-quarters slightly exceeded those of hind-quarters. Such results are in full agreement with those of Maymone (1942). The percentage of fore-quarters ranged from 51.54—52.92.

The highest value was that of 52.92 obtained at the age of 18 months.

The percentage of hind-quarters ranged from 47.37 at the age of 50 days to 47.08 at the age of 24 months and the highest values was obtained at the age of 6 months (48.64).

TABLE 1.—**Percentage of Fore and Hind-Quarters**

	50 days	6 months	12 months	18 months	24 months
Fore Quarters .	51.54	50.99	50.45	52.96	52.92
Hind Quarters. .	47.37	48.64	47.71	46.61	47.08

Meat Cuts :

Cuts studied were dissected to estimate fat, bone, and lean percentage. The following results were obtained (Tables from 2 to 9).

TABLE 2.—**Meat Cuts of Half Carcass. Average Fresh and Chilled Weight. The Actual and Relative Percentage of Meat Components for Veals 50 days old.**

CUT	Aver, Wt. Fresh	Aver. Wt. Chilled	Lean		Fat		Bone	
			Aver. Wt.	% Wt.	Aver. Wt.	% Wt.	Aver. Wt.	% Wt.
Half carcass. . .	20.17	19.22	13.17	68.52	1.23	6.4	4.82	25.05
Hind shin. . . .	1.44	1.42	.62	43.66	.01	.70	.78	54.93
Top side	.38	.38	.38	1.00	—	—	—	—
Silver+Back Side	2.93	2.59	2.32	89.58	.11	4.25	.15	5.79
Aitch bone . . .	1.29	1.20	.81	67.50	.12	10.00	.28	23.33
Rump	.23	.23	.19	82.61	.04	17.39	—	—
Thick flank . . .	2.01	1.82	1:00	54.94	.16	8.79	.68	37.36
Sir loin	.93	.95	.59	62.11	.09	9.47	.25	26.31
Thin flank . . .	.61	.61	.45	73.77	.15	24.59	—	—
5th rib piece . .	.92	.88	.52	59.09	.09	10.23	.27	30.68
8th rib piece . .	1.60	1.50	1.04	69.33	.07	4.67	.45	30.00
Chuck	3.05	2.98	2.21	74.16	.13	4.36	.63	21.14
Plate	2.09	2.00	1.38	69.00	.16	8.0	.43	21.50
Neck	1.61	1.58	1.16	73.42	.09	5.70	.34	21.52
Fore shin . . .	1.08	1.08	.50	46.29	.01	.93	.56	51.85

TABLE 3.—**Meat Cuts of Half Carcass. Average Fresh and Chilled Weight. The Actual and Relative Percentage of Meat Components for Calves 6 months old.**

CUT	Aver. Fresh Wt.	Aver. Wt. Chilled	Lean		Fat		Bone	
			Aver. Wt.	Wt. %	Aver. Wt.	Wt. %	Aver. Wt.	Wt. %
Half Carcass . .	39.44	38.35	26 81	69.91	2.19	5.71	9.31	24.28
Hind shin. . . .	2.35	2.32	.94	40.52	.03	1.29	1.34	57.76
Top side	.72	.71	.70	98.59	.01	1.41	—	—
Silver+Back Side	6.29	6.03	5.49	91.0	.31	5.14	.41	6.80
Aitch bone . . .	1.63	1.52	1.02	67.11	.11	7.24	.45	29.61
Rump	1.14	1.13	1.08	95.49	.04	3.54	—	—
Thick flank . . .	4.46	4.29	2.66	62.00	.33	7.69	1.29	30.07
Sir loin	1.61	1.59	.90	56.60	.18	11.32	.50	31.45
Thin flank . . .	1.10	1.07	.80	74.77	.26	24.30	—	—
5th rib piece . .	1.68	1.61	1.08	67.08	.05	3.10	.46	28.57
8th rib piece . .	2.90	2.84	1.75	61.62	.13	4.58	.91	32.04
Chuck	6.62	6.48	4.95	76.3	.33	5.09	1.18	18.21
Plate	3.90	3.91	2.51	64.19	.28	7.16	1.02	26.09
Clod	3.17	3.03	2.11	69.64	.11	3.63	.79	26.07
Fore shin . . .	1.87	1.82	.82	5.05	.02	1.10	.96	52.75

TABLE 4.—**Meat Cuts of Half Carcass, Average Fresh and Chilled Weight. The Actual and Relative percentage of Meat Components for Bulls 12 months. Old.**

CUT	Aver, Fresh Wt.	Aver. Wt. Chilled	Lean		Fat		Bone	
			Aver. Wt.	Wt. %	Aver. Wt.	Wt. %	Aver. Wt.	Wt. %
Half Carcass . .	57.59	56.04	37.55	67.00	6.60	11.78	11.46	20.45
Hind shin . . .	3.00	2.96	1.35	45.61	.09	3.04	1.47	49.66
Top side	1.02	.97	.94	96.91	.02	2.06	—	—
Silver+Back Side	9.28	9.03	7.92	87.71	.66	7.31	.42	4.65
Aitch bone . . .	3.15	3.02	1.89	62.58	.41	13.58	.69	22.85
Rump	1.63	1.59	1.42	89.31	.15	9.43	—	—
Thick flank . . .	5.29	5.18	3.20	61.78	.48	9.27	1.43	27.61
Sir loin	2.47	2.42	1.44	59.51	.40	16.53	.50	20.66
Thin flank . . .	2.45	2.33	1.45	62.23	.87	37.34	—	—
5th rib piece . .	3.12	2.95	1.47	49.83	.45	15.25	.93	31.53
8th rib piece . .	4.95	4.80	2.99	62.29	.52	10.83	1.19	24.79
Chuck	8.50	8.24	6.15	74.64	.78	9.47	1.47	17.84
Plate	6.41	6.34	3.50	55.21	1.39	21.92	1.31	20.66
Clod	4.03	3.92	2.62	66.84	.33	8.42	.96	24.49
Fore shin . . .	2.29	2.29	1.21	52.84	.05	2.18	1.09	47.60

TABLE 5—**Meat Cuts of Half Carcass. Average Fresh and Chilled Weight. The Actual and Relative Percentage of Meat Components for Bulls 18 months old.**

CUT	Aver. Wt Fresh	Aver. after Chilled	Lean		Fat		Bone	
			Aver. Wt.	% Wt.	Aver. Wt.	% Wt.	Aver. Wt.	% Wt.
Half Carcass . .	91.19	89.15	60.17	67.49	12.01	13.47	16.72	18.75
Hind shin. . . .	4.14	4.08	1.89	46.32	.11	2.70	2.07	50.74
Top side	1.97	1.90	1.79	94.21	.11	5.79	—	—
Silver+Back Side	13.13	12.77	10.72	83.95	1.09	8.54	.83	6.50
Aitch bone . . .	4.55	4.48	2.80	62.50	.72	16.07	.93	20.76
Rump	2.37	2.21	1.67	75.57	.52	23.53	—	—
Thick flank . . .	8.13	7.87	5.13	65.18	.80	10.17	1.98	25.16
Sir loin	3.98	3.93	2.51	63.87	.56	14.25	.86	21.88
Thin flank . . .	4.16	4.06	2.18	53.69	1.91	47.04	—	—
5th rib piece . .	4.07	3.97	1.92	48.36	.94	23.68	1.37	34.51
8th rib piece . .	7.19	6.98	4.47	64.04	.59	8.45	1.75	25.07
Chuck	15.44	15.30	11.33	74.05	1.94	12.68	2.03	13.27
Plate	11.19	11.01	6.50	59.04	2.32	21.07	1.99	18.08
Clod	7.25	7.02	5.30	75.50	.31	4.42	1.41	20.09
Fore shin . . .	3.62	3.57	1.96	54.70	.09	2.52	1.50	42.02

TABLE 6—**Meat Cuts of Half Carcass. Average Fresh and Chilled Weight. The Actual and Relative Percentage of Meat components for Bulls 24 months old.**

CUT	Aver. Wt. Fresh	Aver, Wt. chilled	Lean		Fat		Bone	
			Aver. Wt.	% Wt.	Aver. Wt.	% Wt.	Aver. Wt.	% Wt.
Half Carcass . .	110.37	108.28	75.61	69.83	13.60	12.65	17.61	16.26
Hind shin. . . .	4.75	4.68	2.24	47.86	.07	1.50	2.34	50.00
Top Side	2.24	2.16	2.08	96.30	.07	3.24	—	—
Silver+Back Side	16.94	16.56	14.24	85.99	1.46	8.82	.79	4.77
Aitch bone . . .	5.76	5.65	3.34	59.12	1.01	17.88	.89	15.75
Rump	3.04	2.97	2.32	78.11	.57	19.19	—	—
Thick flank . . .	9.76	9.62	6.36	66.11	.95	9.88	2.19	22.77
Sir loin	5.10	4.96	3.15	63.51	.63	12.70	1.12	22.58
Thin flank . . .	4.88	4.78	2.53	52.93	2.23	46.65	—	—
5th rib piece . .	5.9	5.79	3.82	65.98	.60	10.36	1.27	21.93
8th rib piece . .	8.42	8.25	5.86	71.03	.61	7.39	1.67	20.24
Chuck	19.21	18.90	14.27	75.50	2.12	11.22	2.24	11.85
Plate	13.09	12.90	7.87	61.01	2.87	22.25	2.08	16.12
Clod	7.1	6.98	5.17	74.07	.35	5.01	1.39	19.91
Fore shin . . .	4.16	4.08	2.36	57.84	.06	1.47	1.63	39.95

TABLE 7.—**Meat Cuts of Half Carcass. Average Fresh and Chilled Weight. The Actual and Relative Percentage of Meat Components of Steers 12 months. old.**

CUT	Aver. Wt. Fresh	Aver. Wt. chilled	Lean		Fat		Bone	
			Aver. Wt.	% Wt.	Aver. Wt.	% Wt.	Aver. Wt.	% Wt.
Half Carcass . .	59.22	56.96	36.88	64.75	8.57	15.04	10.79	18.94
Hind shin. . . .	2.97	2.93	1.25	42.66	.17	5.80	1.47	50.17
Top side	1.08	.97	.89	91.75	.02	2.62	—	—
Silver+Back Side	9.36	9.09	7.65	84.16	.83	9.13	.41	4.51
Aitch bone . . .	3.38	3.23	1.96	60.68	.49	15.17	.72	22.29
Rump	1.62	1.36	1.11	81.62	.20	14.71	—	—
Thick flank . . .	5.50	5.33	3.14	58.91	.68	12.76	1.49	27.95
Sir loin	2.94	2.86	1.71	59.79	.62	21.68	.55	19.23
Thin flank . . .	2.96	2.81	1.47	52.31	1.30	46.26	—	—
5th rib piece . .	2.84	2.70	1.36	50.37	.68	25.19	.60	22.22
8th rib piece . .	5.06	4.76	2.90	60.92	.67	4.08	1.13	23.74
Chuck	8.94	8.68	6.44	74.19	.82	9.45	1.44	16.59
Plate	6.33	6.27	3.42	54.55	1.70	27.11	1.08	17.22
Clod	3.94	3.79	2.60	68.60	.28	7.37	.84	22.16
Fore shin . . .	2.30	2.18	.98	44.95	.11	5.05	1.06	50.96

TABLE 8.—**Meat Cuts of Half Carcass. Average Fresh and Chilled Weight. The Actual and Relative Percentage of Meat Components for Steers 18 Months Old.**

CUT	Aver. Wt. Fresh	Aver. Wt. Chilled	Lean		Fat		Bone	
			Aver. Wt.	% Wt.	Aver. Wt.	% Wt.	Aver. Wt.	% Wt.
Half Carcass . .	94.78	92.89	62.66	67.46	12.09	13.01	17.14	18.45
Hind Shin . . .	4.36	4.32	2.05	47.45	.28	6.48	1.99	46.06
Top Side	1.88	1.83	1.70	92.90	.12	6.56	—	—
Silver+Back Side	14.06	13.81	11.06	80.09	1.68	12.17	.94	6.81
Aitch bone . . .	3.87	3.76	2.16	57.45	.69	18.35	.93	24.73
Rump	2.81	2.76	2.01	72.83	.73	26.45	—	—
Thick flank . . .	9.05	8.77	5.78	65.91	1.04	11.86	1.98	22.58
Sir loin	4.30	4.18	2.29	54.79	.61	14.59	1.27	30.58
Thin flank . . .	3.34	3.23	1.69	52.32	1.54	47.68	—	—
5th rib piece . .	4.70	4.61	2.79	60.52	.69	14.97	1.12	24.30
8th rib piece . .	6.06	5.73	3.41	59.51	.40	6.98	1.88	32.81
Chuck	17.46	17.29	13.16	76.06	1.81	10.47	2.27	13.13
Plate	12.01	11.87	7.00	58.97	2.87	24.18	2.07	17.44
Clod	7.19	7.09	5.59	78.84	.23	3.24	1.23	17.35
Fore shin . . .	3.69	3.64	1.97	54.12	.21	5.77	1.46	40.11

TABLE 9.—**Meat Cuts of Half Carcass, Average Fresh and Chilled Weight. The Actual and Relative Percentage of Meat Components for Steers 24 months Old**

CUT	Aver. Wt Fresh	Aver. Wt Chilled	Lean		Fat		Bone	
			Aver. Wt	% Wt	Aver. Wt	% Wt	Aver. Wt	% Wt
Half Carcass . .	118.19	115.54	76.86	66.62	17.38	15.04	19.97	17.29
Hind Shin . . .	5.07	4.99	2.40	48.10	.15	3.01	2.39	47.90
Top Side	2.03	1.97	1.87	94.92	.08	4.06	—	—
Silver+Back Side	17.02	16.76	13.98	83.46	1.96	11.70	.78	4.66
Aitchbone. . . .	6.57	6.44	4.05	62.89	1.12	17.39	1.21	18.79
Rump	3.25	3.10	2.51	80.97	.58	18.71	—	—
Thick flank . . .	10.27	10.08	6.34	52.98	1.20	11.91	2.44	24.21
Sir Loin	5.44	5.33	3.21	60.23	.81	15.20	1.27	23.83
Thin flank . . .	5.80	5.59	2.72	48.66	2.87	51.34	—	—
5th rib Piece . .	5.52	5.28	3.06	57.95	.81	15.34	1.37	25.95
8th rib Piece . .	9.08	8.92	5.38	60.31	1.01	11.32	2.18	24.44
Chuck	21.75	21.23	15.50	73.01	2.85	13.41	2.56	12.06
Plate	14.13	13.90	7.68	55.25	3.56	25.61	2.49	17.91
Clod	7.81	7.63	5.74	75.23	.28	3.67	1.56	20.45
Fore Shin. . . .	4.45	4.32	2.42	56.02	.10	6.94	1.72	39.82

1. *Hind Shin* :

The chilled average weight of this cut at the age of 50 days was 1.42 kg compared with 4.68 kg at the age of 24 months. The highest percentage of lean, fat and bone were at the ages of 24, 12 and 6 months respectively. The lowest percentages of the former components were those at the ages of 6 months, 50 days and 12 months.

2. *Top Side* :

The average chilled weight ranged from 0.38 to 2.16 kg at the ages of 50 days and 24 months. The highest value of lean and fat was that at the age of 50 days and 18 months, while the lowest value was obtained at the ages of 18 months and 50 days.

3. *Silver and Back Side* :

The average chilled weight ranged from 2.59 to 16.56 kg for 50 days and 24 months. The highest percentage for lean, fat and bone were at the ages of 6, 24 and 6 months, while the lowest percentages were at ages of 18, 50 days and 12 months.

4. *Aitchbone* :

The average chilled weight ranged from 1.20 to 5.65 kg. The highest percentage of lean, fat and bone was obtained at the ages of 50 days, 24 and 6 months, while the lowest percentages of the components were those at 24, 6 and 24 months.

5. *Rump* :

The average chilled weight ranged from .23 to 2.97 kg. The highest percentages of lean and fat were at the ages of 6 months and 18 months while the lowest percentages were obtained at ages of 18 and 6 months

6. *Thick Flank* :

The average chilled weight ranged from 1.82 to 9.62 kg. The highest percentages of lean, fat and bone were at 24, 18 months and 50 days while the lowest percentages were at 50 days, 6 and 24 months.

7. *Sir Loin* :

The average chilled weight ranged from .95 to 4.96 kg. The highest percentages of lean, fat and bone were at the age of 18, 12 and 6 months. The lowest percentages were at 6 months, 50 days and 12 months respectively.

8. *Thin Flank* :

The average chilled weight ranged from .61 to 4.78 kg. The highest percentage of lean and fat were at 6 and 18 months, while the lowest percentage were at 24 and 6 months of age respectively.

VIEW OF DORSAL & VENTRAL BUFFALO CARCASSES

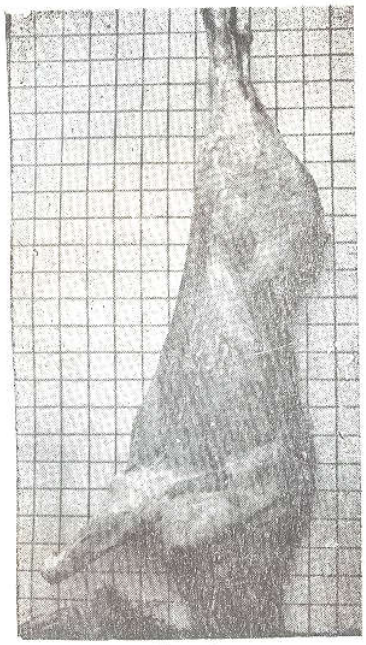

FIG. 1

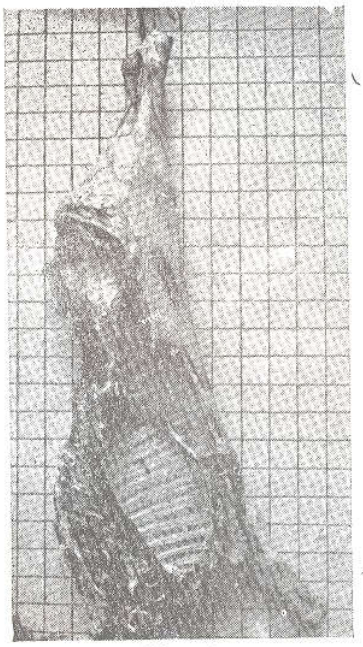

FIG. 2

Age: 10 months (BULLS)

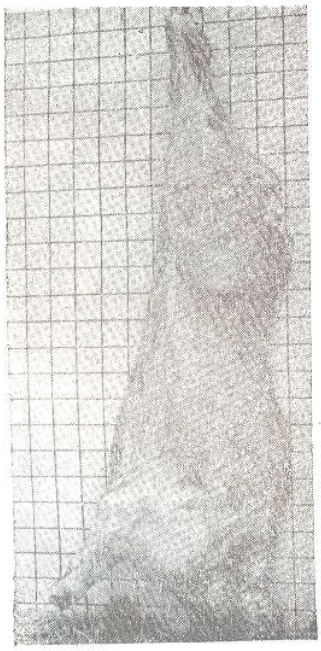

FIG. 3

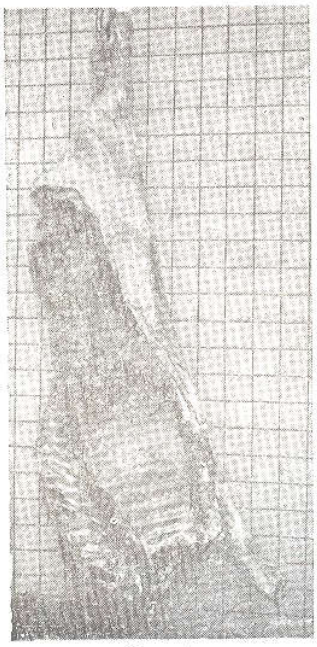

FIG. 4

Age: 18 months (STEERS)

9. *5th Rib Piece* :

The average chilled weight ranged from .88 to 5.79 kg. The highest percentage for lean were at age of 6 months while fat and bone were highest in percentage at the age of 18 months. The lowest percentage for the components were at 18, 6 and 24 months of age.

10. *8th Rib Piece* :

The average chilled weight ranged from 1.50 to 8.65 kg. The highest percentages for lean, fat and bone were at the age of 24, 12 and 6 months for lean and fat and at 24 months of ages.

11. *Chuck* :

The average chilled weight ranged from 2.98 - 18.90 kg. The highest percentages of the lean, fat and bone were at the age of 6, 18 months and 50 days. The lowest percentages were at 18 months, 50 days and 24 months of age.

12. *Brisket and Plate* :

The average chilled weight ranged from 2.-.12.9 kg. The highest percentages were at 50 days, 24 and 6 months for lean, fat and bone respectively. The lowest percentages were at 12, 6 and 24 months.

13. *Clod* :

Chilled weight ranged from 1.51 to 6.98 kg. The highest percentage for lean, fat and bone were at the age of 18, 12 and 6 months. The lowest percentages were at 12, 6 and 24 months of age.

14. *Fore Shin* :

The averaged chilled weight ranged from 1.08 to 4.08 kg. The highest percentages were at the ages of 24, 18 and 6 months for lean, fat and bone. The lowest percentages were at 6 months, 50 days and 24 months.

Tables 7, 8 and 9 show the average weight and the percentage of the components of meat cuts (lean, fat and bone) for buffalo steers at the ages of 12, 18 and 24 months.

Figures from 1 to 4 show the general appearance of buffalo carcasses at the age of 18 month from the dorsal and ventral views for the bulls and steers. It is clear that such carcasses are very similar to cattle carcasses with an exception of the white outlayer of subcutanceous fat. Also the mentioned figures indicate the nearly equal ratio between the fore and hind-quarters. Carcasses of buffalo bulls seems more blocky than those of buffalo steers at the same age.

Correlations between the percentage of dissected lean and fat and carcass measurements i.e. silver side, posterior carcass length, anterior carcass length, chest, depth and area of longissimus dorsi in square c.c. at 13th rib. were .464, .442, .339 and .2 for the irrespective characters.

The only significant relationships (5%) were of the silver side and the posterior length of the carcass. It seems that the rear parts of the carcass is a good indicator for the meatiness of buffaloes.

High priced cuts at the ages except those of steers at 18 months of age exceeded the low priced cuts in both lean and fatty tissue, but were less in the percentage of bone.

High priced cuts as percentage of carcass was nearly constant at different ages (Table 10). Hammond (1960) stated that fattening beef cattle did not affect the percentage of the high priced cuts in such animals but on the contrary increased the low priced cuts.

It may be suggested that fattening should stop at the age of 18 months since fattening older animals will end in increasing the low priced pieces which are the least liked by the consumer.

TABLE 10.—**Percentage Weight of Meat Cuts and Its Components to Chilled Weight in The Right Half Carcass**

Age	State	High Priced Pieces			Low Priced Pieces		
		%	Lean & Fat	Bone	%	Lean & Fat	Bone
50 days	Veals	50.00	39.18	10.82	50.00	35.74	14.26
6 months	Calves	51.79	41.30	10.48	48.11	34.32	13.79
12 „	Bulls	52.68	43.47	9.21	46.56	35.31	11.24
	Steers	52.32	43.73	8.60	46.40	36.06	10.34
18 „	Bulls	49.42	40.76	8.66	50.30	40.20	10.10
	Steers	48.75	40.00	8.74	51.05	41.34	9.71
24 „	Bulls	50.79	43.47	7.32	47.86	38.93	8.94
	Steers	49.52	41.52	8.00	49.32	40.04	9.28

Chilling of Meat :

The percentage of loss due to chilling at 0°C for 24 hours in the case of veals (50 days old claves) was 4.71 % while it was 2.76, 2.69, 2.24 and 1.89 for animals at the ages of 6, 12, 18 and 24 months respectively.

Chemical analysis showed that young animals had higher percentage of moisture than the older ones, therefore, the higher moisture content in the meat the more is the loss due to chilling.

Chilled buffalo meat irrespective of age was lighter in colour than in fresh meat. As buffalo meat is known to be of a relatively dark colour than cattle meat, chilling could be considered as a practical way for making buffalo meat more appetizing in appearance.

Chilling also helps in converting muscle glycogen into lactic acid thus reducing the pH of meat. In all meat studied, the pH in fresh meat ranged from 6.67 to 6.3. After chilling the reduction in the pH value was 1.34 in the 50 days old claves, but only. 23 in the 24 months bullocks meat (Table 11).

TABLE 11.—**pH of Fresh and Chilled Meat. Loss Due to Chilling as Percentage to Carcass at Different Ages**

Age	State	pH Determination			% Loss Chilling
		in fresh meat	after chilling	Differences	
50 days	Veal	6.67	5.33	1.34	4.71
6 months . . .	Calves	6.95	5.93	1.02	2.76
12 ,,	Bulls	6.23	5.80	.43	2.69
	Steers	6.33	5.80	.53	3.82
18 ,,	Bulls	6.63	5.67	.96	2.24
	Steers	6.20	5.60	.60	1.99
24 ,,	Bulls	6.30	6.07	.23	1.89
	Steers	6.40	6.00	.40	2.24

Pallson (1955) reported that meat with pH 6.2 remains flabby and has very poor keeping quality. Since the pH value of the buffalo meat obtained in this study ranged between 6.2 to 6.95, it could be visualized that if they remain in the butcher's shop for long time without chilling, their quality will be endangered since they will be flabby and liable to deterioration. Chilling seems to be necessary since pH is reduced to 5.33 — 6.07 and therefore the keeping quality would become higher. Also these results denote the fact that the reduction in pH of young animal's meat was more remarkable than in the case of older ones. This means that the preserving quality of young meat is more than that of older animals.

Colour of Meat :

The colour of meat differed according to the age of the animals and the location of the muscle. The meat of young animals i.e. veals and 6 months old was bright red colour, while that of 12 and 18 months was moderate and that of 24 months being the darkest of all. Chilling affected the colour of meat as it was mentioned previously.

Some meat cuts like the top side (biceps femoris) was very bright in colour at all ages meanwhile the round and thin flank were moderate. The sir loin, rump (psoas muscle) and shins were the darkest cuts in colour at all ages.

The red colour of meat is mainly due to myoglobin which is a protein very similar in properties to blood hemoglobin. Calves meat was bright in colour due to the least content of iron in their bodies as they are salely fed on milk which is absolutely free from this element.

With advance in age the meat became darker since the animals start to feed on more iron containing substance and their muscles are pronuncedly used for locomotion *i.e.* walk, run and search for food causing more blood, circulation and more content of myoglobin.

It is expected that muscles covering the chuck and scapula are more active than the thin flank, therefore they are expected to be darker in colour. There are exception to this rule as in case of " fillet steak " which was dark in colour even in buffalo veals. It may be suggested that the location of such muscle being in loin region where the vertebrae are only connected with each other with this muscle and where all the movement of the back of the animal is dependent on the development of this muscle. It could be stated that these muscles demand a good supply of blood to enable them to function perfectly.

Castration was found to reduce the colour of meat since the meat of steers was in general lighter in colour than that of bulls according to Hammond (1960) who stated that castration, lack of exercise, lack of iron in the feed reduce colour of meat.

The fat of buffalo meat is white in colour in all ages and this is different from that of cattle.

The yellow colour of fat is due to the existence of carotene. The buffaloe's fat either in body or in milk is white in colour, this is due to the fact that buffaloes are more comptent than cattle in converting carotene to Vit. A.

Chemical Analysis :

The results obtained in chemical analysis are given in the following (table 12) :

A.—**Effect of Age**

1. *Dry Matter.* — The percentage of dry matter slightly increased as age advanced. It was 22.09, 22.00, 24.07, 22.94, and 23.87% at the age of 50 days, 6,12, 18 and 24 months (table 12).

2. *Protein.*—The percentage of protein followed the same trend of dry matter but more remarkebly. It started with 17.64% at the age of 50 days then it increased as age advanced reaching 20.71% at the age of 24 months.

TABLE 12.—**Chemical Analysis of Buffalo Meat at Different Ages (Average of 4 Cuts)**

Age	Dry Matter	Protein	Marbled fat	Ash
50 days	22.09	17.64	1.25	1.05
6 months	22.00	18.70	.65	1.05
12 ,, ...	24.07	21.94	1.63	.98
18 ,, ...	22.94	19.00	1.30	1.10
24 ,, ...	23.87	20.71	2.57	.81

3. *Ash.*—The trend of change in the case of ash was different from either dry matter or protein as it decreased with the increase in age. It ranged from 1.05 to .81 at ages of 50 days and 24 months.

4. *Ether Extract.*—The percentage of ether extract as represented for marbled fat of muscles was not consistent in increase. There was a tendency to increase with advance in age when the value of ether extract at the age of 50 days is compared to that of 24 months. There is no doubt that there is marked difference between chemical analysis of cattle and buffalo. The results of the present study indicated that the percentage of dry matter of buffalo meat was some what less than that of cattle. Tuma *et al* (1963) reported that in the female Hereford at 6 months, the pH value and the percentage of moisture, ash, ether extract, and protein were 5.61, 72.63, 1.10, 4.25, 21.24%. These estimations at 18 months of age were 5.46, 70.30, 1.03, 6.86 and 21.55% (Tuma *et al* loc. cit.).

B.—Effect of Cut

1. *Sir Loin and Top Side.*—The percentage of dry matter and protein increased with advancing age in these cuts (Tables 13 and 14). The percentage of ash was nearly the same in all ages. The ether extract of muscles as indication of intermuscular fat ranged from 1.41 at the age of 50 days to 2.58 at the age of 24 months in sir loin cut with noticable reduction at 6 and 18 months of age. Meanwhile in topside this value ranged from 1.33 to 1.56 at 50 days and 24 months of age respectively. The reduction in the marbled fat in this cut was not noticable except at 6 months of age (66%).

TABLE 13.—**Chemical Analysis of Sir Loin from Buffaloes of Five Age Groups (Fresh Basis)**

Age	State	D.M.	Protein	Ash	Intermuscular fat
50 days	Veal	22.69	18.02	1.21	1.41
6 months	Calves	21.77	18.84	.95	.49
12 ,,	Bulls	24.16	21.66	.93	1.53
	Steers	26.21	20.35	1.03	2.08
18 ,,	Bulls	23.78	19.04	1.15	.98
	Steers	24.37	20.05	1.13	1.74
24 ,,	Bulls	23.74	21.31	1.13	2.51
	Steers	24.09	21.15	.75	.74

TABLE 14.—**Chemical Analysis of Top Side From Buffaloes of Five Age Groups (Fresh Basis)**

Age	State	D.M.	Protein	Ash	Intermuscular fat
50 days	Veal	21.36	17.55	1.04	1.33
6 months	Calves	22.05	19.07	1.09	.66
12 ,,	Bulls	23.34	21.75	1.05	1.40
	Steers	25.02	19.17	1.12	1.25
18 ,,	Bulls	22.48	18.84	1.08	1.52
	Steers	22.96	19.79	1.07	1.01
24 ,,	Bulls	23.08	20.88	.67	1.56
	Steers	23.32	20.65	.53	1.52

2. *Thin Flank and Chuck.*—The percentage of protein in thin flank was 18.31 at 50 days and increased to 20.12% at 24 months of age (Table 15). The marbled fat showed a gradually increase with advancing age, however there was a reduction at age of 6 months. It ranged from 1.16 to 3.87 at 50 days and 24 months of age. The percentage of ash decreased from 1.08 at 50 days to .82% at the age of 24 months.

On the other hand the percentage of dry matter, protein and marbled fat increased in the chuck with advancing age (Table 16).

The comparison of chemical analysis between high priced and low priced cuts showed that the former are superior in the percentage of protein and ash to the latter ones.

TABLE 15.—**Chemical Analysis of Thin Flank From Buffaloes of Five Age Groups (Fresh Basis)**

Age	State	D.M.	Protein	Ash	Intermuscular fat
50 days	Veal	23.89	18.31	1.08	1.16
6 months . . .	Calves	22.17	18.55	1.16	.86
12 ,, . .	Bulls	25.62	21.17	.94	1.40
	Steers	25.84	18.83	1.15	1.44
18 ,, . .	Bulls	23.41	19.78	1.03	1.48
	Steers	24.95	20.29	1.00	.81
24 ,, . .	Bulls	24.84	20.12	.82	3.87
	Steers	23.67	19.85	.83	2.41

TABLE 16.—**Chemical Analysis of Chuck From Buffaloes of Five Age Groups**

Age	State	D.M.	Protein	Ash	Intermuscular fat
50 days	Veal	20.44	16.66	.87	1.08
6 months . . .	Calves	22.08	18.34	1.01	.60
12 ,, . .	Bulls	23.17	21.34	1.00	2.18
	Steers	23.48	18.51	1.17	2.19
18 ,, . .	Bulls	22.10	18.34	1.13	1.20
	Steers	23.14	19.11	1.11	1.61
24 ,, . .	Bulls	23.82	20.59	.60	2.35
	Steers	22.99	20.24	.65	1.29

Marbling :

The ether extract of longissimus dorsi (without the outer layer of fat) at ribs 9, 10, 11 was studied as an indication of marbling. It is shown in (Table 17) that the highest percentage of marbling was 4.12 at the age of 18 months. It was clear that marbling increased with advancing age. Marbling scores were higher in bulls than in steers at the different ages under study.

It is of great interest to note that marbling in the longissimus dorsi of the male buffalo at the age of 6 and 18 months of age were 2.97 and 4.12%. Such results are contrary to those of Hafez (1952) who reported that marbling is absent in buffalo meat. Such estimation is very important for the palatability and tenderness of buffalo meat and for the biological value for human consumption. However Tuma *et al* (1962) reported that the carcass of female Hereford having a slight amount of marbling contained an average of 6.48% ether extract in the longissimus dorsi muscle while the slightly abundant group had 8.73%.

TABLE 17 —**Marbling Test in The Longissimus Dorsi at The 9,10 and 11th Ribs.**

State	50 days	6 months	12 months	18 months	24 months
Bulls	2.94	2.97	3.19	4.12	2.18
Steers	—	—	3.05	3.99	1.97

* Estimation of ether extract was calculated on the dry basis.

The effect of castration on the mode of fat deposition in the buffalo indicate that in buffalo steers the excess amount of fat are deposited as subcutanceous and caul fat Ragab *et al* (1964). The marbling scores reflect such phenomena as in buffalo bulls which had relatively less amount of total fat had relatively higher percentage of marbling fat in the longissimus dorsi than buffalo steers. It is therefore unessential to castrate male buffaloes.

Measurements of Longissimus Dorsi :

Meat bone ratio for buffalo bulls (Table 18) were 66.81, 65.41, 71.47, 72.03 and 75.35 at ages of 50 days, 6, 12, 18 and 24 months.

For steers this ratio was greater than bulls of the same ages, since it was 72.26, 79.45 and 77.08 at age of 12, 18 and 24 months.

The shape index as an indication of lean and fat in carcasses was calculated from the measurements of the longissimus dorsi at the 13th rib (Table 18) also the same index was calculated for measurement at 9, 10, 11, 12 ribs. All the indices were compared to the actual percentage of lean and fat in the carcass, which increased gradually with advancing age, meanwhile the shape index calculated did not show steady increase as the actual percentage.

The only criteron of longissimus dorsi which may be related to the meatiness is the grid countings in square centimeters which increased with advancing age, though there was no significant correlation between the area of longissimus dorsi and the meatiness of animals. This area was higher in bulls than in steers of 12, 18 and 24 months of age meanwhile the actual percentage of lean and fat in carcass was some-what higher in steers than bulls.

TABLE 18.—Measurements, Shape Index, Area of Longissimus Dorsi and Meat Bone Ratio in Buffalo carcasses at different ages

Age	State	Measurements of longissimus dorsi				Actual meat & bone ratio
		Length	Depth	Shape index	Area CC2	
50 days	Veal	9	4.5	50.00	24	66.81
6 months . . .	Calves	9	4.8	53.33	37	65.41
12 months . .	Bulls	11.5	6	51.64	45	71.47
	Steers	10.7	6	57.47	40	72.26
18 months . .	Bulls	14	6.8	47.62	66	72.03
	Steers	13.3	6.3	48.85	63	79.45
24 months . .	Bulls	14.7	7.8	53.52	85	75.35
	Steers	14.5	8	55.42	75	77.08

Refering to Hirzel (1939), Mason (1953) and Pallson (1955) it is suggested that although cattle and buffalo are from the same family (Bovidae), such estimations may be useful in standard beef cattle and mutton, also large numbers of animals are necessary for such estimation.

It may be concluded that the development of the longissimus dorsi may differ in buffalo at different ages from that of cattle.

REFERENCES

A.O.A.C., Methods of analysis. Ninth edition (1960).—Washington D.C.

Hafez, E.S.E. (1952).—An introduction to Animal Husbandry in the Tropics. Indian Vet. Res. 22, 257, Longmans, London 1959.

Hammond, J. (1960).—Progress in the physiology of farm animals. Butterworth, London.

Hirzel, R. (1939).—Factors affecting quality in mutton and beef with special reference to the proportions of muscle, fat and bone. Thesis M.Sc. Agri. Pretoria.

Mason, I.L. (1953).—Beef production from dairy Shorthorn steers. Dairy Shorthorn J. 22 : 288.

Maymone, B. (1942).—Die Buffelzucht in Italien Zeitschrift Fur Tierzucht.– Und Zuchtung - sbiologie Band 52. Heft. 1.

Pallson, H., Hammond, J. (Editor) (1955).—Progress in the physiology of farm animals. Vol. 2 London : Butterworths.

Ragab, M.T., Darwish, M.Y.H., Malek, A.G.A. (1966). —Meat production from Egyptian Buffaloes. I.—Developmental changes and dressing percentage in a group of Buffalo males. U.A.R. J. Anim. Prod. 6 : 9-28.

Tuma, H.J., Henrickson, R.L., Stephens, D.F. and Ruby Moore (1962).—Influence of marbling and animal age on factors associated with beef quality. J. Anim. Sci. 21 (4) 848-851.

Tuma., H.J., Henrickson, R.L., Odell, G.V. and Stephens, D.F. (1963).—Variation in the physical and chemical characteristics of the longissimus dorsi muscle from animals differing in age. J. Anim. Sci. 22 (2) 354-357.

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٢ ـ الخواص الطبيعية والكيماوية للحم الجاموس

الملخص

يعتبر لحم الجاموس أقل جودة من اللحم البقرى ولكن هذا الرأى ينقصه الدليل المادى • لذلك أجريت هذه الدراسة لمعرفة الخواص الطبيعية والكيماوية للحم الجاموس وتتلخص النتائج فى الآتى :

أولا ـ كانت نسبة الأرباع الأمامية للذبيحة فى أعمار ٥٠ يوما ، ٦ ، ١٢ ، ١٨ ، ٢٤ شهرا هى ٥١ر٥٤ ، ٥٠ر٩٩ ، ٥٠ر٤٥ ، ٥٢ر٩٦ ، ٥٢ر٩٢ ٪ •

ثانيا ـ أجرى تقسيم نصف الذبيحة الأيمن الى قطع اللحم التجارية التالية :

تلبيانكو ـ وش وظهر الفخذ ـ الكولاته ـ الفلتو ـ السمانه ـ بيت الكلاوى ـ والخمسة أضلاع الأخيرة (الريش البريمو) كقطع لحم ممتازة فى حين اعتبرت الموزة الخلفية والأمامية والثمانى أضلاع الأولى (الريش الترسو) والمروحة والدوش والرقبة كقطع منخفضة الثمن نسبيا •

وكذلك درست مكونات كل قطعة من لحم ودهن وعظم ونسبة كل من هذه المكونات •

ثالثا ـ كانت نسبة الفقد فى وزن الذبيحة الناتجة عن التبريد على درجة صفر م° لمدة ٢٤ ساعة بعد الذبح والتقطيع هى :

٧١ر٤ ، ٧٦ر٢ ، ٦٩ر٢ ، ٢٤ر٢ ، ٨٩ر١ ٪ وذلك فى أعمار ٥٠ يوما ، ٦ ، ١٢ ، ١٨ ، ٢٤ شهرا ـ على التوالى ـ وكذلك ظهر أن التبريد يعمل على تحسين خواص لون اللحم الجاموسى حيث يجعله فاتحا •

رابعا ـ تراوحت درجة pH اللحم فى العضلة العينيه عند الضلع ١٣ بين ٦٧ر٦ فى عمر ٥٠ يوما الى ٣٠ر٦ فى سن ٢٤ شهرا وبعد الحفظ بالتبريد يحدث انخفاض فى درجة الـ pH مقداره ٣٤ر١ فى لحم الحيوانات عمر ٥٠ يوما فى حين لا يتعدى هذا الانخفاض ٣٣ر فى لحوم الحيوانات عمر ٢٤ شهرا • ولا شك فى أن هذا الانخفاض يعمل على تحسين خواص اللحوم لأن حامض اللكتيك المتكون يعمل على تطرية نسبية للحوم وأنسجتها العضلية علاوة على أن ارتفاع الحموضة النسبى يقلل من سرعة فساد اللحوم •

خامسا ــ عموما تبــدو لحوم الجاموس غامقة اللون باستثناء لحــوم الحيوانات الصغيرة ويعمل الخصى على جعل اللون أقل دكانة .

سادسا ــ أظهر التحليل الكيماوى للحوم الجاموس لقطع بيت الكلاوى ــ التلبيانكو ــ السرة ــ المروحة ــ على أن نسبة المــادة الجافة والبروتين والرماد والمستخلص الأثيرى للدهون المتخللة للحوم كانت ٢٢ر٠٩ ، ١٧ر٦٤ ، ١ر٠٥ ، ١ر٢٥ ٪ فى عمر ٥٠ يوما فى حين كانت هذه النسب فى لحوم الحيوانات عمر ٢٤ شهرا : ٢٣ر٨٧ ، ٢٠ر٧١ ، ٠ر٨١ ، ٢ر٥٧ ٪ محسوبة على أساس اللحم الطازج ويلاحظ عموما ارتفاع نسبة الرطوبة فى لحوم الجاموس عنه فى الأبقار فى حين فاقت القطع الممتازة فى نسبة البروتين والرماد القطع الغير ممتازة .

وعند حساب درجة التعرق بالدهن (المستخلص الأثيرى للعضلات العينية فقط عند الأضلاع ٩ و ١٠ و ١١) كانت القيم أعلى فى لحوم ذكور الجاموس العادية منها فى الذكور المخصية .

ففى ذكور الجاموس العادية كانت هذه الدرجة ٢ر٩٤ ، ٢ر٩٧ ، ٣ر١٩ ، ٤ر١٢ ، ٢ر١٨ ٪ محسوبة على أساس المــادة الجــافة فى أعمار ٥٠ يوما ، ٦ ، ١٢ ، ١٨ ، ٢٤ شهرا بينما كانت فى ذكور الجاموس المخصــية ٣ر٠٥ ، ٣ر٩٩ ، ١ر٩٧ ٪ فى أعمار ١٢ ، ١٨ ، ٢٤ شهرا مع ملاحظة هامة هى أن التحليل الكيماوى قد أظهر فعلا وجود دهون متخللة لألياف لحم الجاموس والتعرق من الصعب تمييزه بالعين المجردة .

هذا علاوة على أن الخصى فى حد ذاته ليس له تأثير يذكر على مكونات اللحوم من البروتين والمــادة الجافة والرماد ولو أنه يعمل على زيادة قليــلة فى نسبة الدهن .

سابعا ــ أظهرت هذه الدراسات أن أقطار العضلة العينية عند الأضلاع ٩ ، ١٠ ، ١١ ، ١٢ ، ١٣ لا تصلح أن تكون دليلا للتشافى المتوقع للحيــوان وأن مساحة العضلة بالسنتيمتر المربع عند الضلع ١٣ أضبط هذه الأدلة جميعا حيث ان مساحتها تتناسب تناسبا طرديا مع التشافى الحقيقية للحيوان .

فقد وجد أن نسبة التشافى الفعلية تزداد بتقدم العمر فقد بلغت فى الذكور الجاموس ٦٦ر٨١ ، ٦٥ر٤١ ، ٧١ر٤٧ ، ٧٢ر٠٣ ، ٧٥ر٣٥ للاعمار ٥٠ يوما و ٦ ، ١٢ ، ١٨ ، ٢٤ شهرا على التوالى بينما فى الذكور المخصية بلغت نسبة التشافى ٧٢ر٢٦ ، ٧٩ر٤٥ ، ٧٧ر٠٨ ٪ للأعمار ١٢ ، ١٨ ، ٢٤ شهرا .