

## MEAT PRODUCTION FROM EGYPTIAN BUFFALOES

### III.—Tenderness in Buffalo's Meat as Influenced by Age

By

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#### SUMMARY

Studies were made on animals previously described by Ragab *et al* (1964) to know tenderness of buffalo meat of four cuts (top side, sir loin, chuck, thin flank) at different ages. A gradual increase in fiber diameter with advance in age was noticed for the four cuts, meanwhile the number of fibers decreased. The organoleptic tests indicated that buffalo meat was more tender in young animals than in old ones. At the age of 24 months the buffalo meat was found to be too tough to be favoured by the consumer. It seems that the increase in fiber diameter with advance in age has something to do with the toughness of buffalo meat.

The area of fibers per 1 CC<sup>3</sup> was highest in the thin flank and that was due to the largest fiber diameter. The area of connective tissue was largest in the chuck and this makes this cut less tender than other meat cuts.

#### INTRODUCTION

In previous papers the authors (1964) made a study on live weights, dressing percentage, meat bone ratio, meat cuts and chemical characteristics of buffalo meat at different ages. As tenderness varies from one cut to the other, it was thought to study this point in buffalo's meat organoleptically and histologically.

#### MATERIAL AND METHODS

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

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*Tenderness scores :*

Samples from sir loin, top side, thin flank, and chuck were frozen and stored in the freezer until the test was made. Small pieces (about 1 inch×1 inch) were tested organoleptically after being cooked in a dry oven at 100° C for one hour.

A numerical score for tenderness was given as follows :

1 : very tough.

2 : tough.

3 : medium

4 : tender.

5 : very tender.

The degrees of tenderness and toughness were given unbiasedly as the grading persons had no idea about the condition of the animal or the cuts from which the samples were taken.

*Histological Technique :*

Samples were taken from the : sir loin, top side, chuck and thin flank. They were fixed in formal saline 5% and dehydrated in ascending grades of ethyl alcohol for 6 hours in each of 50%, 70%, 80% alcohol and for three hours in 90% alcohol followed by two changes of 95% and absolute alcohol for six hours in each then rinsed in xylol for 3 hours for clearing. Embedding in four changes of parafin wax was carried out at 58° C for six hours. Sections were made using a rotary microtome at a thickness of 10 microns. Staining was by Heamatoxylon counterstained by Van Guesin dye.

*Microscopical Studies :*

Sections representing the different fibers structures at the different ages were studied by means of a microprojector. The fiber diameter, shape, number and area of fibers per field were measured using a micrometer ocular lens. The surface area occupied by the collagen tissue was obtained by subtracting the area of the fibers from the area of the microscopic field. Number, area of fibers, and area of connective tissue per 1 CC<sup>2</sup> were calculated. Standard errors for fibers diameter were calculated according to Snedecor (1950).

## RESULTS AND DISCUSSION

## Organoleptic Tests

1. *Sir Loin* : Scores given by testers ranged from 5 to 2.5. The meat of veals was very tender while it was tender, medium, tender and tough for 6, 12, 18 and 24 months old (Table 1). It is interesting to note that tenderness of this cut was the same at the age of 6 and 18 months, meanwhile the lowest score was at 24 months of age.

2. *Top Side* : Scores for this cut ranged from 4.8 to 1.5 at ages of 50 days and 24 months. The meat was very tender, tender, medium, tender and tough at 50 days, 6, 12, 18 and 24 months of age respectively.

3. *Chuck* : Tenderness scores ranged from 4 to 2. The meat at the corresponding ages was tender, medium, tender and tough.

4. *Thin Flank* : Tenderness scores ranged from 4 to 2. The meat was tender and medium at the ages of 50 days and other ages studied.

TABLE 1.—Scores of The Organoleptic Tests

Age	Sir Loin	Top Side	Chuck	Thin Flank
50 days . . . . .	5.0	4.8	3.5	4.0
6 months . . . . .	4.0	4.0	3.2	3.0
12 „ . . . . .	3.5	3.0	3.0	2.0
18 „ . . . . .	4.0	3.7	3.0	2.5
24 „ . . . . .	2.5	1.5	3.0	3.0
Average . . . . .	3.8	3.4	3.14	2.8

Comparing tenderness of meat cuts with each other, the sir loin cut comes first, then the top side followed by the chuck, while the thin flank comes at last.

It is clear from (Table 1) that the buffalo meat was more tender at younger ages. Therefore, fattening buffalo calves should be stopped at the age of 18 months and not more.

## HISTOLOGICAL STUDIES

## A.—Effect of Age

Histological examinations showed that there was a pronounced increase in fiber diameter with advancing age. The mean fiber diameter for the sirloin, top side, chuck, and thin flank were 17.4, 25.1, 28.3, 37.3 & 42.9 microns at the ages of 50 days, 6, 12, 18 and 24 months respectively (Table 2).

The average number of fibers per 1 CC<sup>2</sup> were 213800 at the age of 50 days and 50800 at the age of 24 months. The area of fibers per 1 CC<sup>2</sup> at ages of 50 days, 6, 12, 18, and 24 months were .69, .73, .82, .81 and .93 respectively. Area of connective tissues calculated per 1 CC<sup>2</sup> were .31, .27, .18, .19, .07 for corresponding ages.

It seems that the increase in fiber diameter with advance in age has something to do with the toughness of meat. The organoleptic tests showed that the tenderness of meat deteriorates as age advance, therefore it could be inferred that the thicker the fibers diameter are, the tougher the meat is.

Strandine *et al* (1949) reported histological studies on 50 principal beef muscles. Both elastic and collagenous fibers varied from muscle to muscle in respect to size and quantity. The correlation coefficient for the histological and organoleptic tenderness was 0.7 which showed that connective tissue is a significant factor influencing tenderness but not the only one.

TABLE 2.—Mean Fiber Diameter, Standard Error, Number and area of fibers and Area of connective tissue per 1 CC<sup>2</sup> for Meat Cuts from five age groups

Age	No. Fibers measured	Fiber Diameter	S.E.	No. Fibers per 1 CC <sup>2</sup>	Area of Fibers	Area of Connective tissue
50 day's . . . .	1000	17.4	±.32	213800	.69	.31
6 months . . . .	1070	25.1	±.68	114400	.73	.27
12 months . . . .	940	28.3	±.72	102600	.82	.18
18 months . . . .	950	37.3	±.78	67000	.81	.19
24 months . . . .	1200	42.9	±2.83	50800	.93	.07

Grain of buffalo meat for the ages 6, 12 and 18 months. The meat of old animals is coarse than that of young animals. The sir loin is finer grained than the chuck. Mag.  $\times$  20.

Fig. 1 : Sir Loin 50 days

Fig. 2 : Sir Loin 6 months

Fig. 3 : Sir Loin 18 months

Fig. 4 : Chuck 50 days

Fig. 5 : Chuck 6 months

Fig. 6 : Chuck 18 months

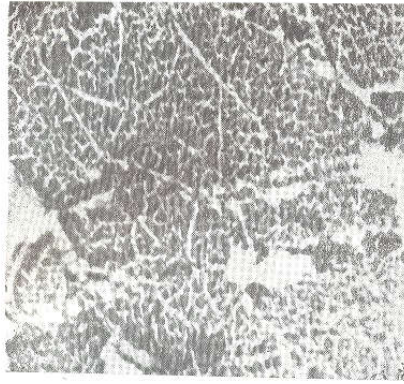


FIG. 1

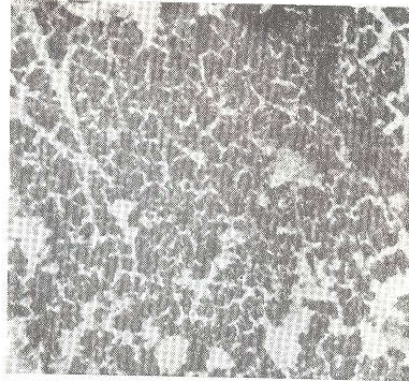


FIG. 4



FIG. 2

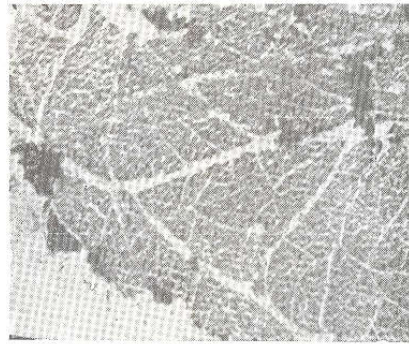


FIG. 5

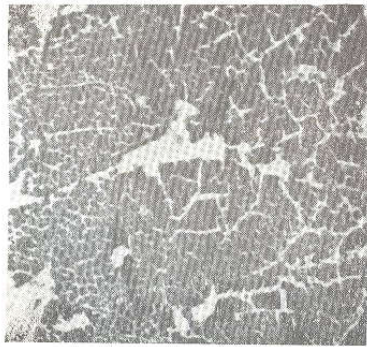


FIG. 3

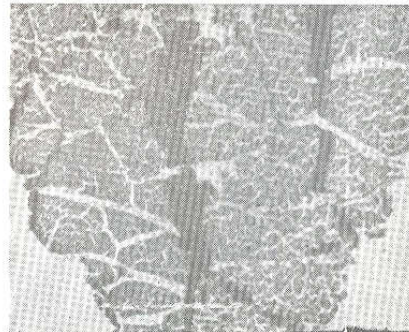


FIG. 6

Brady (1937), Satorius and Child (1938) counted the number of muscle fibers per bundle and concluded that the number of fibers in a bundle is a measure of texture. He stated that the greater the number of fibers in a bundle the finer the texture and since texture is an indication of tenderness, the finer the texture the tenderer the meat.

Ramsbottom *et al* (1949) indicated that muscle fiber diameter was much larger in tough muscle than in tender muscle. Hafez (1952) stated that the coarseness associated with the buffalo meat is not due to any intrinsic defect so much as to the fact that the animals are usually old when they are slaughtered but the meat of six weeks old calf differs in no way from veal.

In this study there are no great differences between the age of 6 and 12 months in this respect. At such ages the muscles were small in diameter and the meat was still palatable. At the ages of 18 and 24 months the fiber diameter increased with advancing age and this is in agreement with Tuma *et al* (1962) who reported that the meat fiber diameter of Hereford for the longissimus dorsi were 53.9, 62.1, 65.1, 69.3 and 71.4 at ages of 6, 18, 24, 42 and 90 months old meanwhile they were 52.5, 63.2, 65.7, 65.7, 64.8 for the semitendinosus muscle at the same ages. It seems that fiber diameter is larger in cattle than in buffalo while the area of connective tissue was smaller in the former than the latter.

The relationship of collagenous and elastic tissue, as measured histologically, to tenderness in beef was investigated by Hasrison *et al* (1949), who found the tenderest roasts, in general, came from muscles and from animals having the least connective tissue.

It could be concluded that buffalo meat at the age of 18 months ranged in quality from tender to moderate. At the age of 24 months the buffalo meat ranged in tenderness from moderate to tough.

The shape of muscle fibers of buffalo meat at different ages were irregular but the majority of them seemed to be polygonal in shape (Fig. 7 to 9).

#### B.—Effect of Cut

1. *Sir Loin*.—The fiber diameter ranged from 18 microns at the age of 50 days to 41.6  $\mu$  at the age of 24 months (Table 3). Number of fibers per 1 CC<sup>2</sup> decreased from 205600 at age of 50 days to 48800 at the age of 24 months. (Fig. 7 to 9).

The area of fibers ranged from .88 CC<sup>2</sup> at the age of 50 days to .84 CC<sup>2</sup> at the age of 24 months. Such area seems to be constant at the different ages.

2. *Top Side*.—The average fibers diameter was 18.2  $\mu$  at the age of 50 days increasing as age increased till it reached 39.2  $\mu$  at the age of 24 months (Table 4). The average number of fibers per 1 CC<sup>2</sup> were 201600 decreasing as age advanced and reaching 59200 at the age of 24 months.

Also the average area of fibers was the least at the age of 50 days (.67) and increasing gradually reaching (.91) when the animals were 24 months old. Meanwhile the average area of the connective tissue decreased as age increased.

3. *Chuck*.—The average fiber diameter was 17.8 and 44.0  $\mu$  for the ages of 50 days and 24 month (Table 5). The area of fibers per 1 CC<sup>3</sup> was .65, .57, .73, .58 and .96 at the ages of 50 days, 6, 12, 18 and 24 months. It may be observed that the area of connective tissue was the highest compared with that of other meat cuts studied. (Fig. 10 to 12).

TABLE 3.—Mean Fiber Diameter, Standard Error, Number, Area and Area of Connective Tissue per 1 CC<sup>3</sup> of Sir Loin Cut from Five Age Groups

Age	No. Fibres measured	Fiber Diameter	S.E.	No. Fibers per 1 CC <sup>3</sup>	Area of Fibers	Area of Connective tissue
50 days . . . . .	300	18	± .45	205600	.88	.12
6 months . . . . .	170	25	± .58	119200	.70	.30
12 ,, . . . . .	170	25.8	± .69	111200	.79	.21
18 ,, . . . . .	200	41.2	±1.34	52800	.90	.10
24 ,, . . . . .	300	41.6	±2.70	48800	.84	.16

TABLE 4.—Mean Fiber Diameter, Standard Error, Number, Area and Area of connective Tissue per 1 CC<sup>3</sup> of Top Side From Five Age Groups

Age	No. Fibres measured	Fiber Diameter	S.E.	No. Fibers per 1 CC <sup>3</sup>	Area of Fibers	Area of Connective tissue
50 days . . . . .	300	18.2	± .30	201600	.67	.33
6 months . . . . .	300	25.2	± .76	107200	.68	.32
12 ,, . . . . .	200	29	± .82	98400	.83	.17
18 ,, . . . . .	300	32.2	± .45	83200	.86	.14
24 ,, . . . . .	300	39.2	±2.96	59200	.91	.09



SECTIONS IN SIR LOIN CUT AT DIFFERENT AGES  
The Fiber Diameter Increased with Advancing Age.  $\times 500$

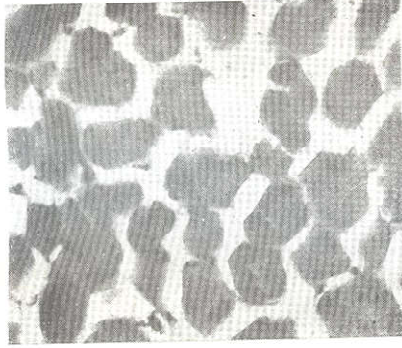


FIG. 7.—Age: 50 days

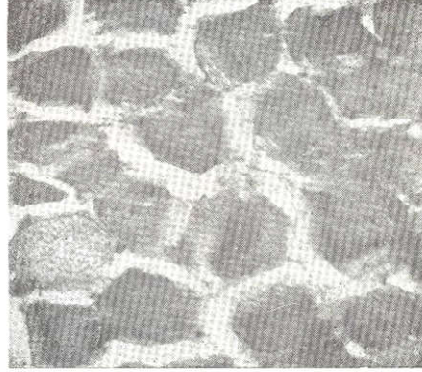


FIG. 8.—Age: 6 months

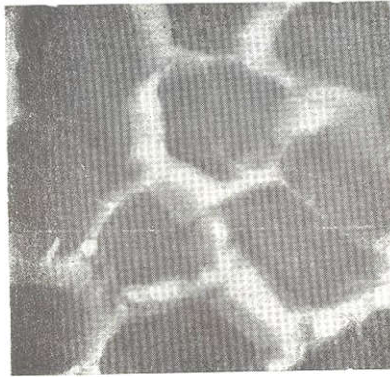


FIG. 9.—Age 18 months

SECTIONS IN CHUCK CUT AT DIFFERENT AGES  
The Fiber Diameter increased with Advancing Age.  $\times 500$

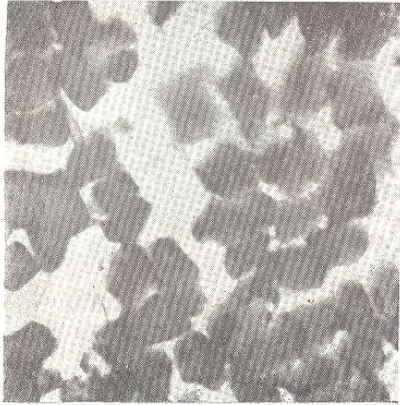


FIG. 10.—Age: 50 days

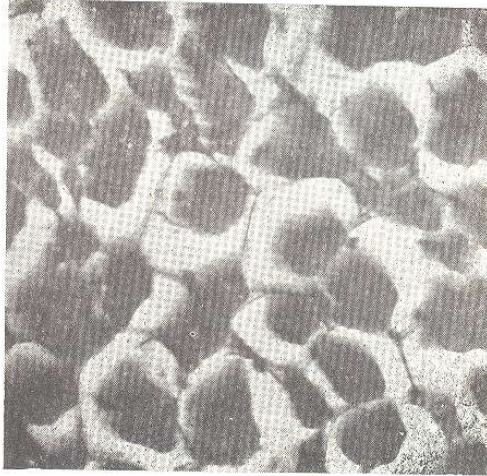


FIG. 11.—Age: 6 months

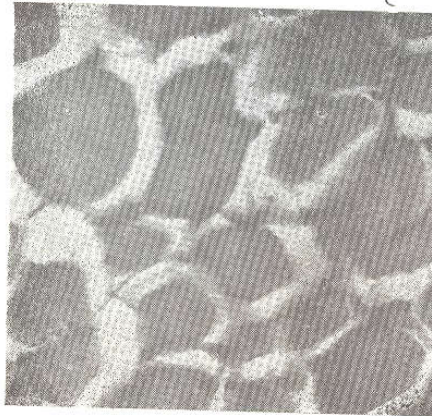


FIG. 12.—Age: 18 months

4. *Thin Flank*.—The fiber diameter ranged from 15.4 to 47.0  $\mu$  at ages of 50 days and 24 months (Table 6). Number of fibers per 1 CC<sup>2</sup> decreased from 241600 to 45600 for the previous ages.

Area of fibers for 1 CC<sup>2</sup> were .57, .98, .92, .90 and 1.00 at the ages of 50 days, 6, 12, 18 and 24 months.

It is of interest to note that this cut had the largest fiber diameter compared with other fibers of the meat cuts studied and this enables more fat to be deposited in this cut of meat (Fig. 13).

It could be concluded that irrespective of cut there was a common trend in the increase of fiber diameter and to the contrary a decrease in number of fibers per 1 CC<sup>2</sup> with advancing age.

TABLE 5.—Fiber Diameter Standard Error, Number and Area per 1 CC<sup>2</sup> of Chuck From Five Age Groups

Age	No. Fibers measured	Fiber Diameter	S.E.	No. Fibers per 1 CC <sup>2</sup>	Area of Fibers	Area of Connective tissue
50 days . . . . .	200	17.8	± .28	206400	.65	.35
6 months . . . . .	300	23.4	± .43	103200	.57	.43
12 ,, . . . . .	400	26.8	± .6	101600	.73	.27
18 ,, . . . . .	150	27	± .66	79200	.58	.42
24 ,, . . . . .	300	44	±2.52	49600	.96	.04

TABLE 6.—Mean Fiber Diameter and Standard Error, Number and Area per 1 CC<sup>2</sup> of Thin Flank From Five Age Groups

Age	No. Fibers measured	Fiber Diameter	S.E.	No. Fibers per 1 CC <sup>2</sup>	Area of Fibers	Area of Connective tissue
50 days . . . . .	200	15.4	± .25	241600	.57	.43
6 months . . . . .	300	26.8	± .95	136000	.98	.02
12 ,, . . . . .	170	31.8	± .77	91200	.92	.08
18 ,, . . . . .	300	41.4	± .68	52800	.90	.10
24 ,, . . . . .	300	47.0	±2.14	45.600	1.00	0.00

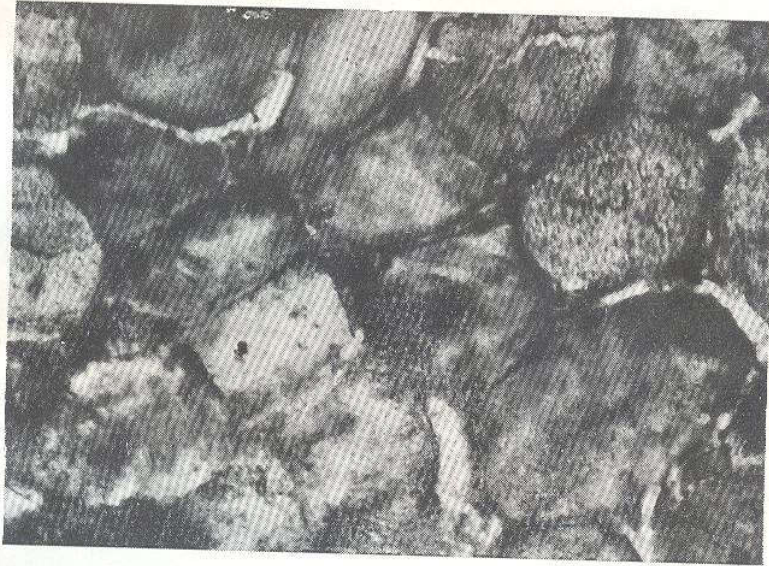


FIG. 13.—Fibers diameter of thin flank were the largest compared with fibers of other meat cuts. This enables more fat to be deposited in the thin flank.

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(Printed in 1968)

### ٣ رخاوة لحم الجاموس ومدى تاثيرها بالمر

#### الملخص

تمت في الأبحاث السابقة دراسة نسبة التصافي والتشافي للجاموس المصرى في الأعمار المختلفة . كما تمت دراسة خواص اللحم الجاموسى الطبيعية والكيميائية

ويهدف هذا البحث الى دراسة رخاوة لحم الجاموس في الأعمار المختلفة باستخدام الطرق الحسية والهيستولوجية وتتلخص النتائج في الآتى :

أولا - دلت الاختبارات الحسية بطريق المضع على أن لحوم الجاموس تكون أكثر طراوة في الحيوانات الصغيرة عنها في الحيوانات الكبيرة وأنه في عمر ٢٤ شهرا تميل هذه اللحوم نحو الخشونة .

ثانيا - أظهرت الدراسات الهيستولوجية أن ألياف لحم الجاموس تزداد ثخانة في قطرها مع تقدم العمر حيث كان متوسط قطر هذه الألياف في كل من بيت الكلاوى والتليانكو والمروحة والسرة في أعمار ٥٠ يوما ، ١٢ ، ١٨ ، ٢٤ شهرا هي ١٧ر٤ ، ٢٥ر١ ، ٢٨ر٣ ، ٣٧ر٤ ، ٤٢ر٩ ميكرون على التوالي . في حين أن عدد الألياف في السنتيمتر الواحد المربع يتناقص مع تقدم العمر ، إذ بلغ العدد ٢١٣٨٠٠ في سن ٥٠ يوما وانخفض الى ٥٠٨٠٠ في سن ٢٤ شهر هذا علاوة على أن شكل ألياف لحم الجاموس غير منتظمة وان كانت تكثر فيها الألياف المتعددة الاضلاع .

وقد لوحظ من الفحص الهيستولوجى ان مساحة النسيج الخام تزداد نسبيا في القطع غير الممتازة . هذا ومع تقدم العمر تصير ألياف لحم الجاموس أقل رخاوة ويعتقد أن هذا يرجع الى ازدياد قطر ألياف اللحم علاوة على التغيرات التى تحدث في مساحة مكونات النسيج الخام .

كما لوحظ أن ألياف السرة كانت أكبر في القطر من ألياف بيت الكلاوى والتليانكو والمروحة .