

THE POSSIBILITY OF IMPROVING THE YIELD AND
QUALITY OF BUFFALO MEAT BY CROSSING

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Introduction

Wherever the buffalo exists it is mostly used as a drought animal and therefore it may be undoubtedly stated that the working potential is its most pronounced characteristic. This is due to the natural selection under severe conditions, through centuries. Only animals with great muscular capacity for hard work and exceptional resistance to the unfavourable conditions were able to survive.

In all cases, however, when improved methods of breeding were introduced, it was indicated that buffalo has not only outstanding working potential but also much better abilities for milk production than it was supposed. Fairly high yields of milk, especially butterfat, are common where modern methods of selective breeding, proper management and nutrition were applied.

So far the most neglected and ignored productive characteristic of buffalo was the meat production and its quality. Generally speaking, buffalo meat, along with hide, is commonly considered as a by-product obtained from animals which are not more useful for work or milk production. Also, when the calves are not intended as replacement for drought or milking animals, they are forcibly weaned and allowed to starve without using their growing period for meat production. In addition to this, in some areas there are prejudice or religious prohibition against the eating of buffalo

All these factors have contributed to the rather low yields and inferior quality of buffalo meat commonly produced.

It can be concluded that the low yields and poor reputation of buffalo meat are primarily a result of unfavourable circumstances under which it has been generally produced. This statement may be confirmed by many investigations carried out all over the world. Due to the restricted space it is impossible to mention and comment all these very interesting results. We should stress, however, that we did not find any data about the comparative investigations of different breeds and crosses of buffalo under equal conditions. Namely, we consider that the method of crossing different breeds of buffalo could offer similar achievements to those obtained with other farm animals. Therefore we decided to carry out several experiments in order to give some contribution to the improvement of the production and utilization of buffalo meat. This programme was encouraged by the FAO in order to find out in what extent buffalo could give significant contribution to meet the growing needs for meat in the developing countries.

In this paper we are ready to present the results of an experiment which was organized to examine the fattening abilities, carcass yield, carcass composition and meat quality of Bulgarian buffalo, Murrah breed (imported from India) and their crosses.

Material and methods

This investigation is a result of collaboration between the Institute for Animal Production, Shumen (Bulgaria) and the Department of Meat Technology, Faculty of Agriculture, Belgrade (Yugoslavia). The fattening and slaughtering of animals was carried out in Shumen while the other research work was accomplished in Belgrade.

Three groups of noncastrated male buffalos were formed: the first consisted of 7 animals of the native Bulgarian buffalo, the second was represented by 5 animals of the imported Murrah breed and the third was composed of 7 animals obtained by crossing of Bulgarian buffalo with Murrah breed.

The average age at the start of fattening was fairly uniform in all groups /tab. 1/. The fattening period lasted 130 days for all groups and the rations were equal. They consisted of 40% concentrated feed mixture, 40% cob meal, and 20% of alfalfa hay. The mixture was composed of: 40% corn /maize/ meal, 20% wheat bran, 20% sunflower oil meal, 15% barley meal, 3% dicalciumphosphate and 2% salt. Individual feeding was organized so that individual feed consumption and conversion was recorded. For all analyses the usual standard methods were applied.

Results and Discussion

1. Live Weight Gain and Feed Conversion

In the table 1. it may be seen that crosses have had, at the same age, 24 kgs greater average live weight than the Bulgarian buffalo but only 8 kgs greater than the Murrah buffalo. During the fattening period, however, the crosses had practically the same average daily weight gain as the Bulgarian buffalo, while the Murrah breed showed slightly lower daily gains. But when the lower transportation shrinkage and the higher dressing out percentage are taken in consideration, it may be stated that practically no significant differences in daily gains were found between these three groups. It is worth pointing out that all three groups achieved considerably great daily gains and very good feed conversion which demonstrates that buffalo is able to achieve rather great daily gains, at the age of about 12 months, if properly fattened.

The daily gains in many other experiments ranged between 0.500 kgs to 1.200 kgs which seems to be affected by the age, sex, method of feeding and the size of the breed. We consider that the body size influences very much the daily weight gains. This may be proved also in our experiment. Namely, the group of the Bulgarian buffalo was composed by animals which derived from a bull whose parents weighted over 1.000 kgs. This seems to offer great possibilities for increasing the daily gains by considering size in selection.

2. The Yield of Carcass and By-products

The dressing out percentage was in all three groups considerably high showing only small differences in favour to the Murrah group. When the relative yields of particular by-products are taken in consideration, it may be seen that the somewhat greater dressing out percentage in Murrah buffalo could be a result of the smaller hide weight compared with the other two groups.

There are many data in the literature about the carcass yield of buffalo but only a few of them refer to the dressing out percentage of animals with known history. Furthermore, the published data sometimes are uncomparable due to the various styles of dressing practiced in different countries. In general, much more investigators refer dressing out percentages under 47% than over 50%. Here again, many data indicate considerably great individual differences which give good possibilities for improvement by proper selection.

3. Carcass Composition

The left sides of the carcasses obtained from three animals of each group were dissected and separated into lean meat, separable fat, bone and tendons. The three rib cuts /10th, 11th and 12th/ were taken from all slaughtered animals and separated into lean meat, fat and bone. This data are presented in the table 2.

As it may be seen in the table 2. the differences in carcass composition among the three tested groups were rather small, either when the whole sides or the three rib cuts were dissected. However, by both methods crosses have showed some greater amount of separable fat and bone and equally smaller amount of total lean meat in comparison with the murrah and bulgarian breed.

Our results confirm the data given by some of the investigators/4,7,13/ showing that the proportion of lean, fat and bone is quite satisfactory in buffalo carcasses. More than that, we found approximately 2-4% smaller bone content than all other authors did which may be primarily due to the very favourable age /weight and degree of finish which achieved animals in our experiment.

It is worth mentioning that the three rib cuts of buffalo seem not to represent the tissue ratio in such an accuracy as in cattle. Namely, we found in three rib cuts about 6-8% less lean meat, 5-7% more separable fat and 1-2% more bone content compared with the actual tissue ratio in the whole sides.

4. Some Chemical and Physical Characteristics of Muscle Tissue

Intramuscular fat, myoglobin and oxyproline content as well as the muscle fiber diameter were established in the m. longissimus dorsi taken from all tested animals. The results are presented in tab. 3.

Significant difference was found only in fat content between Murrah buffalo and Bulgarian buffalo. In all other characteristics the differences among the groups were smaller but logical. Namely, the amount of myoglobine and oxyproline as well as the muscle fiber diameter, were somewhat greater in the meat of Bulgarian buffalo which showed at the same time slightly darker colour, inferior texture and less tender meat compared with the crosses and the animals of Murrah breed (tab. 6).

The amino acid composition was analysed by the method described by Moore, Steine and Specman, modified by Dзамич-Velichovic, using the Unichrom - Beckman analyser. The results are presented in the table 4 as percentages of the fresh samples.

In relation of most amino acids analysed, three were of significant differences among the three tested groups. This is especially the case with the amount of Aspartic acid, Threonine, Serine, Glycine, Valine, Methionine, Isoleucine, Leucine and Phenylalanine. The meat of Murrah buffalo, however, when compared with the other two groups, showed only a higher content of Lysine, while the Bulgarian buffalo had in comparison with other two groups a smaller content of Arginine, Glutamic acid and Cystine, but a greater amount of Proline. The latter is very indicative as it is in accordance with the findings of a greater Oxyproline content /tab. 3/ as well as with the evaluation of meat tenderness /tab. 6/. Namely, this indicates that the meat of Bulgarian buffalo contains more, and probably even coarser connective tissue than the meat of Murrah breed and crosses.

5. Palatability Characteristics of Meat

The eating quality was tested by panel method using the ranking system. The samples were taken from the m. longissimus and prepared by three methods of thermal treatment: dry heating, heating in fat and boiling in water until the temperature of 70°C was reached in the centre of the pieces. In the table 5 the losses in weight due to thermal treatment are shown, and in table 6 the summarized results of the taste testing are presented.

From the table 5 it follows that no significant differences in weight loss were found by dry heating. When thermal treatment in fat and in water, however, the meat of the crosses showed considerable smaller loss in weight than the meat of Bulgarian buffalo and slightly smaller loss in weight than the meat of Murrah buffalo. Although we are not able to present precise explanation of this phenomenon, we may point out to the connection of it with inferior tenderness and juiciness which is proved by panel testing /table 6/.

The summarized results of ranking the samples of meat of the three tested groups are given for tenderness, juiciness, flavour, texture and general acceptability (tab. 6). The panel testing was carried out with fresh meat, 36 hours after slaughter /A/, and aged meat, 5 days after slaughter /B/. The meat of Murrah buffalo and the crosses showed better palatability characteristics than the meat of Bulgarian buffalo, especially with regard to tenderness, juiciness and general acceptability, while regarding the flavour and texture these differences among the groups were rather smaller.

CONCLUSION

On the basis of the results obtained the following conclusions may be drawn:

1. At the age of about one year, the crosses showed a greater weight at start of fattening than both parents breeds. Certainly, the difference in this respect was greater in comparison with Bulgarian buffalo than with Murrah breed. This seems to be a result of increased vigor with the crosses due to heterosis.
2. During the fattening period there were no significant differences regarding daily weight gains among the three tested groups. Attention should be paid to the very good daily gains and feed conversions which were achieved by all three groups.
3. Carcass yield of about 54% may be considered as a fairly high dressing out percentage, especially when rather low separable fat content, we found by dissection, is taken into account. The Murrah breed showed somewhat lighter hide than the other two groups and this has certainly contributed to an analogous greater dressing out percentage if compared with both groups.
4. The production of lean, separable fat and bone in all three tested groups was quite satisfactory. Somewhat greater amounts of separable fat and bone content were found in carcasses of the crosses than in Murrah breed and in Bulgarian buffalo.
5. The three rib cuts do not represent the tissue ratio in buffalo carcasses with such an accuracy as in cattle, showing more separable fat and bone than it actually is.

6. The meat of Bulgarian buffalo had a somewhat greater content of Myoglobine and Oxyproline which is in accordance with the darker colour and less tender meat we found by panel testing.

7. The amino acid composition indicates a greater content of connective tissue in the muscle of Bulgarian buffalo in comparison with the Murrah breed and the crosses.

8. The crosses and the Murrah breed showed definite advantages regarding palatability characteristics: tenderness, juiciness, texture and general acceptability. With regard to flavour the crosses ^{were} superior compared with both other groups.

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Table 1. The L. Weight Gain, Yield of Carcass and By-products

	Bulg. Buffalo	Murrah Buffalo	Vros.F ₁ Mur x B.
1. Number of animals tested	7	5	7
2. Age at start of Fattening (months)	11.7	11.6	11.0
3. Days of fattening	130	130	130
4. Initial L.Weight at fattening kg	242.8	258.6	266.6
5. Final L.Weight at fattening kg	376.0	374.0	401.0
6. Average daily gain kg	1.024	0.951	1.035
7. Feed conversion OFU	7.24	7.77	7.25
8. Transportation shrinkage %	3.67	2.19	3.32
9. L.Weight at slaughter kg	362.2	365.8	387.8
10. Chilled carcass weight kg	194.6	200.0	209.7
11. Dressing out percentage %	53.73	54.67	54.07
12. The yield of by-products :			
- Hide %	13.94	12.46	14.05
- Head %	3.87	3.66	3.91
- Feet %	1.95	1.99	1.83
- Heart %	0.36	0.43	0.37
- Lung %	0.52	0.56	0.49
- Liver %	1.12	1.15	1.12
- Kidneys %	0.20	0.26	0.17
- Tongue %	0.23	0.27	0.19

Table 2. Tissue ration in the whole carcass and in
Three rib cuts

	Bulgarian Buffalo		Murrah Buffalo		Cross. F ₁ Murr x Bulg	
	kg	%	kg	%	kg	%
I. Whole Carcass :						
1.Weight of the left side	102.7	100	100.8	100	100.3	100
2.Lean meat 1th quality	45.86	44.65	44.6	44.24	46.24	46.16
3.Lean meat 2nd quality	28.00	27.26	26.07	25.86	23.03	22.96
4.Total lean meat (2 + 3)	73.86	71.91	70.76	70.10	69.63	69.42
5.Separable fat	10.16	9.89	9.97	9.89	11.40	11.36
6.Bone	17.30	16.84	18.03	17.08	17.40	17.34
7.Tendons	1.40	1.36	1.93	1.91	1.80	1.79
II.Three rib cuts :						
1.Weight of cuts	2.61	100	2.79	100	3.17	100
2.Lean meat	1.74	66.74	1.88	67.38	1.95	61.50
3.Separable bone	0.40	15.34	0.44	15.77	0.59	18.61
4.Bone	0.46	17.64	0.47	16.84	0.63	19.87
III.Eye Muscle Area (cm²) cm²/100 kg Carc.Weight						

Table 3. Some Characteristics of Muscle Tissue

	Bulgarian Buffalo	Murrah Buffalo	Crosses F ₁ Murr x Bulg
1.Fat content %	1.36	0.64	1.04
2.Myoglobin	1.53	1.40	1.37
3.Oxyproline	0.78	0.74	0.70
4.Muscle Fiber diameter	58.83	57.14	56.67

Table 4. The content of Amino Acids in M.Long.Dorsi

Amino Acid	Bulgarian Buffalo	Murrah Buffalo	Crosses F ₁ Murr. x Bulgar.
Lyzine	1.800	2.162	1.722
Histidine	0.767	0.868	0.835
Arginine	1.218	1.435	1.422
Aspertic Acid	2.555	2.518	2.625
Threonine	1.172	1.186	1.231
Serine	0.874	0.899	0.926
Glutamic Acid	3.965	4.311	4.154
Proline	1.185	0.914	0.928
Glycine	1.066	1.053	1.051
Alanine	1.416	1.571	1.488
Cystine	0.363	0.523	0.544
Valine	1.318	1.370	1.355
Methionine	0.646	0.660	0.659
Isoleucine	1.227	1.159	1.233
Leucine	1.878	1.825	1.952
Tyrosine	0.816	0.871	0.894
Phenylalanine	0.904	0.955	0.966

Table 5. Shrinkage During Thermal Treatment

Methods of Thermal Treatment	Bulgarian Buffalo	Murrah Buffalo	Crosses F_1 Murrah x Bulg.
I. Dry Heating:			
1. In. weight /g/	115.72	117.10	125.45
2. Fin. weight /g/	68.27	65.36	74.34
Weight loss /g/	47.45	51.74	51.11
Weight loss /%/	41.01	42.02	40.74
II. Heating in Fat:			
1. In. weight /g/	42.73	48.91	45.22
2. Final weight/g/	26.35	30.54	29.05
Weight loss /g/	16.38	18.37	16.17
Weight loss /%/	38.34	37.74	35.73
III. Boiling in Water:			
1. In. Weight /g/	44.87	50.63	51.05
2. Final weight/g/	31.21	35.87	37.88
Weight loss /g/	13.68	14.74	13.17
Weight loss /%/	30.82	29.22	25.91

Table 6. Palatability Characteristics of Meat

	Bulgarian buffalo		Murrah buffalo		Crosses F_1 Murrah x Bulg.	
	A	B	A	B	A	B
1. Tenderness	2.3	2.1	1.7	1.9	1.8	1.9
2. Juiciness	2.6	2.6	1.6	1.6	1.4	1.8
3. Flavour	2.5	1.8	2.0	2.0	1.3	1.8
4. Texture	2.3	2.0	1.7	2.0	1.7	1.9
5. Gen. acceptability	2.1	2.0	1.5	1.9	1.8	1.9