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Original Contribution

STUDY ON THE EFFECT OF SOME BIOLOGICAL AND ECONOMIC FACTORS ON THE PROFIT IN FATTENING BEEF BULLOCKS

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ABSTRACT

The efficiency of beef cattle breeding is limited by the productive performance of animals, by the systems of fattening and purchasing and by the prime cost of the produce. In order to establish the relationship among these, 87 bullocks have been studied. The animals belong to two productive types – beef and dairy breeds. They have been fattened under two systems – in barns and combined (including pasture period and subsequent fattening in a barn). The effect of the studied factors was shown using various linear models.

Fattening system and age have had a reliable influence on the prime cost per kg of yield and kg of live weight with all breeds. The combined fattening and the younger age are prerequisites for lower prime cost. Various breed groups, and not the fattening systems, have influenced the slaughter yield. The lower prime cost per kg of yield does not guarantee the lower prime cost per kg of live weight. A reliable influence has been recorded with regard to the prime cost per kg of live weight on the profit per kg of live weight. Purchasing by live weight is not an incentive for the production of well fattened bullocks with high slaughter yield.

Key words: Bullocks, breed, systems of fattening and purchasing, profit

INTRODUCTION

One of the sectors in our agriculture and in particular in animal breeding that has been influenced to a large extent by the processes or reorganisation taking place in Bulgaria is beef cattle breeding According to data produced by Dimova (1) over a ten-year period, the number of young animals for fattening decreased by 26,6%, the number of young cattle sold out for beef, by 47,8%, and their total live weight, by 48,0%. The production of beef per capita has also considerably decreased from 11 kg per capital for 1970s to 8 kg for 1999 (2). The relative share of beef from the total amount of meat produced in the country was comparatively lower and it has decreased from 22,34% in 1992 to 12,93% in 2000 (3).

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The reasons for this poor animal breeding profile are complex. One of them is the low purchase price of fattened animals with an associated high price of concentrated fodder, which results in low profit and the attendant loss for the producer. The other reason is the lack of effective functioning regulatory and purchasing systems that should stimulate the production of animals with higher meat qualities.

In many countries, as well as in our country, the main source of beef is the male bullocks from the dairy breeds. Fisher and Wood (4) pointed out that in England dairy cows were 60% more than the beef ones, but one third of them were inseminated by bulls from beef breeds. A similar variant was offered for our realities by Videv in 1996 (5). Another source of beef production is the specialised beef breeds, which, due to lack of incentive at present in our country, are very rare.

Legoshin et al, (6) stated that in the developed countries the increase in beef production during the recent decade had

resulted from the increase of slaughter weight of cattle. At present in the European countries, the average weight of the slaughtered carcass is 300-340 kg with 58-60% slaughtered yield. One of the problems in a number of countries, as well as in our country, is the lack of a purchasing system that will stimulate the fattening of cattle to greater live weight and accumulation of muscles.

The factor that can stimulate the development of this branch is to make profit that will guarantee both reproduction on the farm and secure normal incomes for the owner. Since profit depends to a large extent on production costs, producers aim to reduce them and hence, reduce the prime cost of the produce. This goal leads to the implementation of low-cost fattening systems resulting in low profit due to small weight and quality of the slaughtered carcass (7). The results from the studies by a number of authors revealed that in order to maximise the profit when we take into account the difference in prices for quality, the duration of the fattening period for one-year-old bullocks has to be longer than the commonly adopted practice. The prolonged period is compensated by achieving a higher percentage of animals with better slaughter parameters for which a category with a higher price is given (4, 8, 9, 10).

The objective of this paper is to study the effect of some biological and economic factors on profit in treating different bred male bullocks with different systems of fattening and purchasing.

MATERIAL AND METHODS

The research was carried out at the experimental base of the Complex Agricultural Station "Strandzha-Sakar" in the town of Sredets, county of Burgas in Bulgaria. In order to achieve the goal a scientific and economic experiment was carried out by fattening male bullocks from four different breeds selected from the following: Polled Hereford - PH (33 pcs.), Beef three breed crossbreds - BTBC (16 pcs.), Native grey cattle – NGC (22 pcs.) and Black and white breed – BWB (16 pcs.). The bullocks from each breed were divided into two subgroups according to the system of fattening – year-round in a barn and combined, including pasture period and period of further fattening in a barn. In the course of the fattening in a barn (for both systems), bullocks were reared under the same conditions – free in group boxes in a closed building. During fattening in a barn all groups were fed the same whole-ration mixture based on 50% straw. The mixture was fed *ad libitum* and quantities consumed by each group recorded.

Bullocks were fattened until they reached the desired live weights for slaughter, which were 350 kg and 450 kg for the NGC and the other breeds, respectively. The final live weight was in conformity with the current standard regulations BDS 873-73, which guarantees maximum payment in purchasing that weight.

In order to calculate the economic parameters the following were controlled and calculated in the course of fattening: costs for forage, labour costs and other costs, including costs for preventive and medical treatment, water supply, electricity, transport, depreciations, etc. On that basis the prime cost of yield was calculated. After adding the value of the calf upon purchasing, the prime cost of live weight was calculated. Both prime costs were calculated for 1 kg of yield and 1 kg of live weight. The incomes from the sale and the profit were calculated on the basis of the relevant prices for both purchasing system currently in use in Bulgaria – pr kg of live weight and kg of carcass weight.

Due to the difference in prices at the time of the experiment and at present, as well as their possible future variations, the so-called Derived Unit (DU) was used in calculating the economic parameters. The purchase price per kg of live weight was chosen as base price for the dairy breeds and dual-purpose ones (BWB and BBC and NGC), while all other prices and costs were calculated as percentage from it. Due to the fact that purchase prices for beef cattle and crossbreeds were higher than those of diary and dual-purpose breeds, the analyses were made separately for the breed groups with similar productive performance and the respective purchase prices.

The basic statistical processing was carried out using the respective modules of "Statistica" Software (STATISTIKA Software – N 1234).

Linear models were used in order to study the variation and the relationship between factors and signs. The solutions of the equations were done by the synthesised method of the least square means (LSM), and the components of the variances were assesssed according to the ANOVA paradigm.

In order to establish the degree of influence of the different factors the following model of the most general kind was used:

$\mathbf{Y_{ijk}= \mu+A_i+F_j+e_{ijk}}$

Where: $\mathbf{Y_{ijk}}$ is the dependent variable (the stuided parameter), μ is the average value for the excerpt; $\mathbf{A_i}$ is the **i**-th effect on each fixed factor, included as a class in the model; $\mathbf{F_j}$ is the **j**-th effect of the other fixed factors, corresponding to the non-class independent variables; $\mathbf{e_{ijk}}$ is the effect of the non-included accidental effects (except μ).

Models of the same kind were employed for each of the studied parameters and they are presented in the respective tables for variance analysis in "**Results and discussion**".

From the analysis of the variance models for each class of fixed factors the following were obtained – the least square means (**LSM**) and the grades of the least square means (**LS**-estimation) which are the sum total of the squares calculated as deviations from the average parameter of the value obtained from the model. The LSM errors were also given – SE. LSM values are only presented and discussed for significant effective factors.

RESULTS AND DISCUSSION

The average age of bullocks at the beginning of fattening was about one year and there was no significant difference between the groups of one and the same breed, except for the NGC – **Table 1**. Live weight at slaughter for all groups was achieved as specified in the aim. Slaughter yield differed not only by breeds but also by the fattening system with one and the same breed. No special regularity was observed in relation to the fattening system. Bullocks from the Hereford and NGC breeds with combined fattening had relatively low growth yield compared to those in barns, but with BWB and the three breed crossbreds a similar dependence was not observed.

Table 1. Average values of the basic biological and economic parameters for fattening bullocks by breeds and fattening systems

Parameters	Breed groups							
	PH/b	PH/c	NGC/b	NGC/c	BWB/b	BWB/c	BTBC/b	BTBC /c
Biological parameters								
Number of bullocks in the group – pcs.	19	14	11	11	8	8	8	8
Age at the beginning – days	354,53	391,21	315,82	402,45	334,37	334,62	335,25	320,87
Live weight at slaughter- kg	448,32	441,21	346,00	362,91	460,12	474,50	448,37	445,00
Slaughter yield - %	55,44	53,04	52,31	47,95	55,77	55,32	55,67	56,48
Economic parameters								
Prime cost of growth per 1 lg of live weight – DU	0,299	0,199	0,302	0,206	0,350	0,276	0,353	0,249
Initial cost of bullock per 1 kg of live weight – DU	0,581	0,657	0,515	0,627	0,337	0,362	0,561	0,569
Prime cost per 1 kg of live weight – DU	0,880	0,856	0,817	0,833	0,687	0,638	0,914	0,818
At purchase by live weight								
Incomes per 1 kg of live weight – DU	1,413	1,391	1,114	1,114	1,053	1,086	1,437	1,428
Profit per 1 kg of live weight – DU	0,533	0,535	0,297	0,281	0,366	0,448	0,523	0,661
At purchase by carcass weight								
Incomes per 1 kg of live weight – DU	1,494	1,426	1,105	1,027	1,113	1,150	1,540	1,527
Profit per 1 kg of live weight – DU	0,614	0,570	0,288	0,194	0,426	0,512	0,626	0,709
Diference of profit /2-1/ DU	+ 0,081	+ 0,035	- 0,009	- 0,087	+ 0,060	+ 0,064	+ 0,103	+ 0,099

The submitted mean values of economic parameters varied considerably in bullocks from different breeds and systems of fattening and purchasing. The initial price of the bullock per kg of live weight had high relative share from the prime cost per kg of live weight and it varied considerably by groups – from 49,05% for the BWB – in barns, to 76,75% for the PH – combined. The following regularity was not observed – with lower prime cost of the bullock the prime cost per 1 kg of live weight to be lower as well. The direct comparison between bullocks from different breed groups by that parameter was a difficult task due to the fact that their purchase price differed according to the productive types – higher for the beef and lower for the dairy and dual-purpose type. Similar was the situation with the profit per 1 kg of live weight due to the varying purchase prices. Due to these considerations the analyses of the effect of the various factors were made separately for both productive types.

From the variance analysis – **Table 2**, it was established that the breed had reliable influence only on the prime cost per 1 kg of live weight for the dairy breeds ($p<0,001$). The prime cost per 1 kg of live weight was considerably higher for NGC bullocks compared to that of BWB bullocks. This was probably accounted for by the fact that NGC bullocks had been fattened to a smaller live weight at slaughter. As a result of that all expenses – for purchasing the calf and its fattening, divided by the final live weight, gave higher prime cost. With beef bullocks there was no reliable influence of the breed type on that parameter but for them there was no significant difference in live weight at slaughter.

Table 2. Analysis of the variance for the effect of some biological factors on the prime cost per kilogram of growth and kilogram of live weight

Factors	**Degrees of freedom (n-1)**	**Prime cost per 1 kg of growth**		**Prime cost per 1 kg of live weight**	
		Beef breed F P	Dairy and dual-purpose breed F P	Beef breed F P	Dairy and dual-purpose breed F P
Total for the model	49/38"	13,26***	22,64***	4,80***	22,64***
μu - yμ	1	0,43-	0,06-	1,18-	15,42**
Breed	1	0,11-	0,04-	0,48-	53,73***
Fattening system	1	55,82***	36,14***	20,71***	9,01**
Age at the beginning of the fattening period	3	8,17***	7,08***	4,86**	9,71***
Slaughter yield	2	0,45-	0,76-	4,67*	0,95-

Note: "the first figure refers to the number of beef bullocks and the second one – for the dairy ones.
* - $p<0,05$; ** - $p<0,01$; *** - $p<0,001$

The fattening system had had a reliable influence both on prime cost of yield ($p<0,001$) and prime cost per kg of live weight ($p<0,01$; $p<0,001$) for all breeds. It is one of the basic factors having an influence on the prime cost. The reason for that was the considerably lower cost for the combined fattening compared to the ones in barns. Because of that prime cost, both of growth yield and per kg of live weight, was reliably lower for the combined fattening system (**Table 3**).

The obtained slaughter yield in fattening influenced reliably not only the prime cost per kg of live weight for the beef bullocks ($p<0,05$). The higher slaughter yield resulted in lower prime cost per kg of live weight, which was typical for the beef breeds and crossbreeds. They utilise better the nutritive substances and with intensive fattening for shorter period of time they reached the desired weight at a high growth yield.

Another important factor that had a reliable effect on both prime costs was the age at the beginning of fattening for bullocks of all breed groups (**Table 2**). With calves arriving at an older age – about and over 12 months, the prime cost per kg of yield decreased – **Table 3**. This was accounted for by the fact that for older calves the period for reaching the slaughter age was shorter and hence, costs were reduced. The average prime cost per kg of growth yield was almost the same with a tendency to become higher for the dairy and dual-purpose breed types.

The prime cost of growth yield is an important parameter that reflects the cost for

production of fattened bullocks but more important for the economic efficiency of production is the prime cost per kg of live weight. The age of bullocks at the beginning of fattening has an adverse effect on the prime cost per kg of live weight compared to its effect on the prime cost of growth yield. The increase of the initial age resulted in an increase of prime cost per kg of live weight – **Table 3**. This accounted for by the fact that arriving at an older age, respectively, with higher live weight, the price of bullocks was higher.

Table 3. Estimations and LS-means of the effect of bullock age at the beginning of the fattening period and the fattening system on prime cost

Variation sources	Beef breed					Dairy and dual-purpose breeds				
	Number	Prime cost per 1 kg of growth		Prime cost per 1 kg of live weight		Number	Prime cost per 1 kg of growth		Prime cost per 1 kg of live weight	
		Estim.	LS ± SE	Estim.	LS ± SE		Estim.	LS ± SE	Estim.	LS ± SE
Average for the model	49	-	0,281±0,01	-	0,881±0,01	38	-	0,295±0,01	-	0,725±0,01
Age at the beginning of the fattening period:										
Under 280 days	6	+0,030	0,311±0,02	-0,051	0,831±0,02	5	+0,015	0,309±0,02	-0,109	0,615±0,02
From 281 to 340 daysи	13	+0,026	0,307±0,01	-0,003	0,878±0,02	11	+0,028	0,323±0,01	+0,030	0,755±0,02
From 341 to 400 days	17	+0,006	0,287±0,01	+0,035	0,917±0,02	13	+0,008	0,303±0,01	+0,044	0,768±0,01
Over 401 days	13	-0,062	0,218±0,02	+0,019	0,901±0,02	9	-0,051	0,244±0,01	+0,034	0,759±0,02
Fattening system:										
In barns	27	+0,049	0,330±0,01	+0,032	0,914±0,01	19	+0,034	0,329±0,01	+0,023	0,747±0,01
Combined	22	-0,049	0,232±0,01	-0,032	0,849±0,01	19	-0,034	0,261±0,01	-0,023	0,701±0,01

This was confirmed by the analysis of the effect of the basic biological factors on the initial price of the calf per kg of live weight – **Table 4**. The basic factor that had an effect on it was the age of calves at the time of purchasing. By increasing the age the costs for purchasing per kg of live weight also increased for bullocks of both types ($p<0,001$). With bullocks of the dairy and dual-purpose type the breed itself also had a reliable influence on the initial price of the calf as part of the final live weight ($p<0,001$). The reason for that was the lower final live weight of slaughter of NGC, upon which these costs were divided.

Table 4. Analysis of the variance of the effect of some biological factors on the costs of bullock purchasing per 1 kg of live weight

Factors	Degrees of freedom (n-1)	Beef breed F	Beef breed P	Dairy and dual-purpose breed F	Dairy and dual-purpose breed P
Total for the model	49/38	8,07***		73,02***	
μU - Yμ	1	2,37-		18,62**	
Breed	1	0,13-		118,09***	
Age of bullock at the beginning of fattening	3	10,69***		28,17***	

These make one to suggest that fattening bullocks has to start at a younger age – 8-10 months. This will give a lower price for purchase and lower prime cost per 1 kg of live weight. The lower prime cost of growth yield does not guarantee better fattening efficiency achieved in the final result – prime cost per 1 kg of produced live weight.

Profit depends on the system of purchasing and the difference in prices according to the productive type. The analysis on **Table 5** shows that prime cost per 1 kg of live weight had a reliable influence on profit per kg of live weight when purchasing by live weight for the two productive types. The high prime cost of production per 1 kg of live weight resulted in lower profit in the long run. Breed

and slaughter yield had no reliable influence on profit with this system of purchasing. This shows that when purchasing by live weight, producers have no incentive to fatten animals to a greater slaughter yield. The prime cost of growth yield also has a reliable influence on profit for the dairy breeds with this system of purchasing, but not for the beef breeds.

Table 5. Analysis of the variance of the effect of some biological and economic factors on the profit per kilogram of live weight with two systems of purchasing

Factors	Degrees of freedom (n-1)	Profit in purchasing by live weight		Profit in purchasing by carcass weight	
		Beef breed	Dairy and dual-purpose breed	Beef breed	Dairy and dual--purpose breed
		F P	F P	F P	F P
Total for the model	49/38"	26,74***	9,29***	17,19***	13,48***
μu - yμ	1	0,32-	3,20-	1,15-	0,34-
Breed	1	0,02-	1,55-	5,05*	0,95-
Prime cost per kg of growth	3	1,97-	3,93*	1,74-	5,20*
Prime cost per kg of live weight	2	82,68***	10,21***	21,43***	2,83*
Slaughter yield	2	1,79-	0,72-	23,51***	10,74***

Note: "the first figure refers to the number of beef bullocks and the second one – for the dairy ones.
* - p<0,05; ** - p<0,01; *** - p<0,001

The prime cost per kg of live weight has a reliable influence on profit when purchasing by carcass weight. Reliable influence of the slaughter yield has also been recorded. Profit is higher for animals with higher slaughter yield for both productive types.

The breed has a reliable influence only for the beef type. The beef crossbreeds have a reliably higher profit per kg of live weight compared to the Hereford regardless of the fattening system.

Table 6. Grades and means of the effect of yield prime cost on the profit per kg of live weight for the dairy and dual-purpose breeds

Variation sources	Number	Purchasing by live weight		Purchasing by carcass weight	
		LS-estimation	LSM±SE	LS-estimation	LSM±SE
Average for the model	38	-	0,326± 0,02	-	0,355 ± 0,03
Prime cost per kg of growth					
Under 0,200 DU	5	+0,029	0,356 ± 0,04	-0,009	0,346 ± 0,05
From 0,201 to 0,300 DU	15	+0,019	0,346 ± 0,02	+0,058	0,414 ± 0,03
Over 0,301 DU	18	-0,049	0,277 ± 0,02	-0,049	0,312 ± 0,02

The prime cost of growth yield has a reliable influence on profit only for the dairy breeds. When purchasing by live weight the high prime cost of growth yielded definitely results in lower profit – **Table 6**. This is related to the increase of production costs resulting in decrease of profit without taking into consideration the quality of fattened bullocks. When purchasing by carcass weight both high and low prime cost result in lower profit. Only animals with an average prime cost give higher profit per kg of live weight. With this system of purchasing the attained slaughter yield also has a reliable influence on profit. The extremely high prime cost of growth yield results in an increase of the total prime cost per kg of produced live weight, which cannot be compensated by a possible higher slaughter yield.

CONCLUSIONS

1. The higher prime cost per kg of live weight is not directly related to the prime cost per kg of growth yield, but is influenced to a large extent by the initial price of bullocks for fattening.
2. The aim at lower prime cost of the growth yield can have a positive influence on profit only when fattening bullocks of non-beef types and purchasing by live weight.

3. The purchasing by live weight provides no incentive for producers to produce better fattened bullocks, with higher slaughter yield. The obtaining of a higher profit is related mainly to the lower prime cost per kg of live weight of beef bullocks and the higher purchase price according to the breed type.
4. When purchasing by carcass weight the profit depends reliably on the slaughter yield, too. The application of that system will stimulate the production of bullocks with good beef qualities.

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