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**Growth characteristics of calves given milk replacements with various protein and calorie levels**

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**Abstract**

The goal of the study was to determine how various milk substitute formulations impacted the conversion, mass, and growth of calves. 116 male Holstein calves were divided into control and experimental groups during a period of 59 days. The experimental group's calves were fed a milk substitute that contained bacteria. There were no statistically significant differences between the groups at the end of the experiment, despite the control group's higher average body mass and average daily gain figures. The conversion of the milk substitute was lower in the experimental group. The cost of the total average growth of a male calf (EUR 51.8) of the Holstein-Friesian breed in the control group, is lower compared to the cost of a male calf (EUR 58.96) of the Holstein-Friesian breed in the experimental group.

*Key words:* calves; production characteristics; milk substitute

**Introduction**

Since milk substitutes began to be used, production technology has been constantly developing so that the milk substitutes we use today in feeding calves represent nutritionally valuable liquid feed.

(S.M. Grobler, 2008). In earlier research, different production results obtained from the use were recorded milk substitutes and milk. Some studies have shown better results in daily gain, body mass, and conversion of calves using milk compared to milk substitutes (Godden et al., 2005; Ivanković et al., 2013), while some studies resulted in better or uniform results

In production characteristics (Hill et al., 2008; El-Jack and Ahmed 2012). Drackley (2004) states in his work that lower daily gains, body weights, and feed conversion of calves were

obtained in earlier research due to insufficient protein in milk substitutes. The same author states that energy also affects the mentioned production characteristics and that it is an important source of energy in the milk substitute, that is, it originates whether energy comes from lactose or fat. In some research, feeding calves a milk replacer with a higher protein level resulted in higher daily growth (Nonnecke et al., 2003; Cowles et al., 2006). More recently, diverse microbiological preparations such as yeasts, probiotics, and prebiotics are sometimes added to milk substitutes. Geiger et al. (2014) used a milk substitute with probiotics in their research and compared it with a milk substitute that contained a higher level of protein and energy and a milk substitute with a higher protein level that did not show better production characteristics. The aim of this work is to compare different types of milk replacers on daily gain, body weight, and conversion milk substitutes in calves.

### Material and Methods

In total, 116 male Holstein calves were used in the study. Calves were brought from two farms. They were split into two groups: control (38 and 21 calves) and experimental (45 and 12 calves). The calves were 30 days old on average. The experimental group received one milk substitute that was continuously enriched with yeast microorganisms (*Saccharomyces cerevisiae*) during the whole experiment, while the control group received two milk substitutes (initial and final). The first, thirty-first, and sixty-ninth days of the trial saw each participant weighed individually. The calves were given a set amount of milk substitute each day, along with hay and a starting combination (18% crude protein), which they could eat at any time. Each animal's consumption of milk substitute was tracked on an individual basis using a trans. All data were processed with the STATISTICA program (StatSoft Inc. 2012).

Table 1. Content of nutrients and energy in milk replacements

| Nutrients and energy   | Control group          |                         | Experimental group                   |
|------------------------|------------------------|-------------------------|--------------------------------------|
|                        | 0-30 days of age       | 30-60 days              | 0-60 days                            |
|                        | first milk replacement | second milk replacement | milk replacement with microorganisms |
| Crude protein (%)      | 22                     | 22                      | 21,5                                 |
| Crude fat (%)          | 20                     | 17                      | 18,5                                 |
| Crude fiber (%)        | 0                      | 0,07                    | 0,3                                  |
| Metabolic energy MJ/kg | 18,48                  | 17,8                    | 18,38                                |

## Results and Discussion

In calves from the first farm, the experimental group was significantly older at entry, with a mean age of 32 days (SD 6.3 days) (Student's t-test,  $p = 0.001$ ). In the second farm (student's t-test,  $p = 0.001$ ) and Belje (student's t-test,  $p = 0.009$ ), there was a significantly higher increase from the 30th to the 59th day in the calves of the experimental group. The price of a kilogram of calf growth (1.03 eur/kg) from the farms of the first farm in the control group, calculated on the basis of milk substitute consumption, is lower than the price of calf growth (1.09 eur/kg) in the experimental group. The cost of feeding per calf day (0.88 eur/FD) in the control group is lower than the cost of feeding per calf day (0.99 HRK/FD) in the experimental group. The cost of the total average gain of calves (51.8 euros) in the control group, calculated based on the consumption of milk replacers, is lower compared to the cost of calves (58.96 euros) in the experimental group. The cost price per kilogram of calf gain (0.89 eur/kg) from another farm in the control group, calculated on the basis of milk replacer consumption, is lower compared to the cost price of calf gain (0.93 eur/kg) in the experimental group. The cost of feeding per calf day (0.87 eur/FD) in the control group is lower than the cost of feeding per calf day (1.02 eur/FD) in the experimental group. The cost price of the total average gain of the calf (51.33 eur) in the control group, calculated on the basis of the consumption of milk replacer, is lower compared to the cost price of the calf (60.12 eur) in the experimental group. (Table 2).

Table 2. Average parameters in male Holstein-Friesian calves according to origin and type of milk replacement

| Holstein-Friesian breed<br>Male calves              | Arithmetic mean<br>(standard deviation) |               | Difference | 95%<br>confidence<br>interval |       | P*           |
|---|---|---------------|------------|-------------------------------|-------|--------------|
|   | Control                                 | Experimental  |            | From                          | to    |              |
| <b>The First farm</b>                               | n=38                                    | n=45          |            |                               |       |              |
| Age [days]  | 28 (5,5)                                | 32 (6,3)      | -4         | -7,04                         | -1,92 | <b>0,001</b> |
| Input mass [kg]                                     | 60,95<br>(6,8)                          | 60,77 (7,1)   | 1,55       | -3,18                         | 3,00  | 0,953        |
| Weight at the 2nd weighing<br>(after 30 days) [kg]  | 81,24<br>(8,8)                          | 80,96 (9,4)   | 2,02       | -4,04                         | 4,01  | 0,994        |
| Gain until the 2nd weighing<br>[kg].                | 20,3<br>(5,7)                           | 20,1 (5,7)    | 0,15       | -2,36                         | 2,66  | 0,907        |
| Gain until the second<br>weighing (30 days) [kg/FD] | 0,68<br>(0,2)                           | 0,67 (0,2)    | 0,04       | -0,08                         | 0,09  | 0,954        |
| Weight at the 3rd weigh-in<br>(after 59 days) [kg]  | 111,11<br>(13,4)                        | 114,77 (13,7) | 3,02       | -9,99                         | 2,03  | 0,192        |
| Gain from the 2nd to the<br>3rd [kg].               | 29,8<br>(6,6)                           | 33,8 (6,4)    | 3,94       | -6,79                         | -1,09 | <b>0,007</b> |

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| Holstein-Friesian breed<br>Male calves  | Arithmetic mean<br>(standard deviation) |               | Difference | 95%<br>confidence<br>interval |       | P*               |
|---|---|---------------|------------|-------------------------------|-------|------------------|
|   | Control                                 | Experimental  |            | From                          | to    |                  |
| Gain from the 2nd to the<br>3rd [kg/FD].  | 0,85<br>(0,2)                           | 1,17 (0,2)    | 0,04       | -0,41                         | -0,23 | <b>&lt;0,001</b> |
| The total amount of milk<br>substitute consumed [kg]                                | 33,0<br>(0,5)                           | 33,1 (1,3)    | -0,1       | -0,51                         | 0,36  | 0,729            |
| Gain per feeding day [kg]   | 1,03<br>(0,2)                           | 0,91 (0,2)    | 0,04       | -0,14                         | 0,01  | 0,093            |
| Gain per head [kg]  | 50,16<br>(10,3)                         | 53,96 (10,13) | 3,797      | -8,30                         | 0,70  | 0,097            |
| Cost per kg of growth<br>based on consumption of<br>MR, eur/kg                      | 1,03                                    | 1,09          |            |                               |       |                  |
| FD cost price based on MR<br>consumption, eur/kg                                    | 0,88                                    | 0,99          |            |                               |       |                  |
| The cost price of the total<br>gain per calf based on the<br>consumption of MR, eur | 51,8                                    | 58,69         |            |                               |       |                  |
| <b>The second farm</b>  | n=21                                    | n=12          |            |                               |       |                  |
| Age [days]  | 35 (7,4)                                | 33 (8,7)      | 2          | -3,37                         | 8,79  | 0,368            |
| Input mass [kg]   | 57,95<br>(8,4)                          | 57,59 (11,2)  | 3,55       | -7,59                         | 6,96  | 0,930            |
| Weight at the 2nd weighing<br>(after 30 days) [kg]                                  | 80,57<br>(10,9)                         | 83,87 (17,1)  | 5,02       | -                             | 8,31  | 0,697            |
| Gain until the 2nd weighing<br>[kg].  | 22,6<br>(5,6)                           | 24,9 (10,3)   | 2,29       | -8,00                         | 3,41  | 0,417            |
| Gain until the second<br>weighing (30 days) [kg/FD]                                 | 0,75<br>(0,2)                           | 0,88 (0,3)    | 0,10       | -0,25                         | 0,14  | 0,567            |
| Weight at the 3rd weigh-in<br>(after 59 days) [kg]                                  | 116,47<br>(15)                          | 120,71 (27,6) | 7,73       | -                             | 11,59 | 0,588            |
| Gain from the 2nd to the<br>3rd [kg].   | 34,6<br>(6,5)                           | 36,9 (11,8)   | 2,26       | -9,1                          | 4,56  | 0,502            |
| Gain from the 2nd to the<br>3rd [kg/FD].  | 0,98<br>(0,2)                           | 1,27 (0,4)    | 0,10       | -0,50                         | -0,08 | <b>0,009</b>     |
| The total amount of milk<br>substitute consumed [kg]                                | 32,6<br>(2,6)                           | 33,9 (0,7)    | -1,3       | -2,91                         | 0,39  | 0,130            |
| Gain per feeding day [kg]   | 0,99<br>(0,2)                           | 1,07 (0,3)    | 0,09       | -0,25                         | 0,12  | 0,473            |
| Gain per head [kg]  | 57,84<br>(8,9)                          | 61,76 (20,6)  | 3,92       | -                             | 7,12  | 0,473            |
| Cost per kg of growth<br>based on consumption of<br>MR, eur/kg                      | 0,89                                    | 0,93          |            |                               |       |                  |
| FD cost price based on MR<br>consumption, eur/kg                                    | 0,87                                    | 1,02          |            |                               |       |                  |

| Holstein-Friesian breed<br>Male calves  | Arithmetic mean<br>(standard deviation) |              | Difference | 95%<br>confidence<br>interval |    | P* |
|---|---|--------------|------------|-------------------------------|----|----|
|   | Control                                 | Experimental |            | From                          | to |    |
| The cost price of the total<br>gain per calf based on the<br>consumption of MR, eur | 51,33                                   | 60,12        |            |                               |    |    |

MR - milk replacement, FD - feeding days

Table 2 shows that in the first period of fattening from the first farm (first 30 days), the average daily gain was higher in the control group by 10 g/day (0.68:0.67 kg/day). In the second period, the average daily gain was higher in the experimental group by 140 g compared to the calves of the control group (1.17: 1.03 kg). The total daily gain of the experimental group was higher by 60 g compared to the calves of the control group (0.91: 0.85 kg/day).

In calves from another farm, the average daily gain in the first period was higher in the experimental group of calves by 130 g compared to the calves of the control group (0.83: 0.75 kg/day). In the second period, the average daily gain was higher in the experimental group of calves by 40 g compared to the calves of the control group (1.27: 1.23 kg/day). The total average daily gain is higher in the experimental group of calves by 80 g compared to the calves of the control group (0.99: 1.07 kg). The findings are consistent with those of Lee et al. (2008), who found no statistically significant differences in calf body mass. Geiger et al. (2014) obtained better results using a milk replacer enriched with microorganisms.

### **Conclusion**

The calves of the experimental group fed with a milk substitute containing microorganisms had a higher final body weight than the calves of the control group, even though they had a lower level of crude protein in the mixture. The gain was lower in the experimental group in the first part of the experiment by 10 grams compared to the control group, while in the second farm, the gain was higher (24.9: 22.6 kg/FD) In the second part of the experiment, the gain of the calves in the experimental group was higher (300, 290 grams) than that of the calves in the control group, which is probably the result of lower energy content in the milk substitute of the control group. The calves in the experimental group used the nutrients from the meal better because a lower feed conversion per kg of gain was recorded. The obtained results clearly indicate that the use of microorganisms in milk substitutes improves the utilization of nutrients, which ultimately directly affects the reduction of greenhouse gases.

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## Карактеристике раста телади којој су даване млијечне замјене с различитим разинама протеина и калорија

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### Сажетак

Циљ студије био је утврдити како млијечне алтернативе различитих састава утјечу на претворбу, масу и раст телади. Тијеком 59 дана, 116 мушке Холштајн телади подијељено је у двије групе: контролну групу и покусну групу. Иако су вриједности просјечне тјелесне масе и просјечног дневног прираста контролне групе биле веће на крају експеримента, није било статистички значајних разлика између група. У покусној групи дошло је до смањене конверзије млијечне замјене.

*Кључне ријечи:* мушка телад, производне карактеристике, млијечна замјеница