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THE USE OF WHEY POWDER IN KIDS ARTIFICIAL REARING IN AN ENVIRONMENTAL FRIENDLY APPROACH

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ABSTRACT

Whey is a major end-product and accepted as one of pollutant for environment in dairy industry. In this study, whey powder was added to cow milk to compose a milk replacer for kids. 23 Saanen kids at the same age were allotted into 2 groups. 13 kids in the Control Group (CG) were fed by solely mother milk, and 10 kids in the experimental Group (EG) were fed by the milk replacer. The average daily gain between the two groups was compared and no statistically significant differences were found. The differences between EG and CG with regard to glucose and urea levels were found statistically insignificant. These results indicated that kids could be nourished with a milk replacer prepared by adding whey powder into cow milk instead of using the mother milk, which could be marketed in much more profitable ways.

KEYWORDS:
Whey powder, milk, kids rearing, growth

INTRODUCTION

Since goat milk is a well-known valuable nutrient in dairy sector, breeders have to employ different applications to transfer it to more profitable forms while raising healthy kids. One way of managing this, is the use of milk replacers to feed the kids after 5 days postpartum. It is vitally significant to give the kids colostrum during the first 3-5 days postpartum [1]. Afterwards, the kids could be raised feeding them goat, cow or sheep milk, or milk replacers containing different energy-protein rates [2,3]. Among these alternatives, cow milk is the cheapest and the most abundant and could be used to reduce the costs in the artificial feeding of the kids, but it doesn't have the necessary nutrients and could cause some digestion problems for kids. However, it could be an ideal milk replacer when whey and milk powder are added into it and goat milk could be used in more profitable ways [4,5].

Whey is a waste from cheese industry which causes important environmental hazards during its disposal and holds a big share in dairy sector (Figure 1, 2). Since whey is a waste that requires high biological oxygen demand (BOD 40 000-60 000 ppm), the release of it to the environment causes pollution in addition to extremely serious environmental hazards in the long run [4,5]. Dairy sector in Europe composes the greatest industrial wastewater source and it is strictly forbidden to release it even to sewerage without being processed [6]. On the other hand, in the countries like Turkey, where whey is not evaluated enough, it is directly released into the flowing rivers causing environmental hazards which end the life in fresh water (Figure 3). Moreover, this kind of a discharge leads to the waste of the nutrients in the whey which has a high nutritional value that could be used in many sectors ranging from food products to cosmetics and health. Whey in liquid form could be used directly or indirectly in feeding farm animals after being processed. It is generally used in animal's diet as "mixed food" by mixing it with grains [7]. In ruminants, it was observed that the digestibility of the dry material in the fodder definitely increased when the fodder was softened by whey instead of normal water. It was also stated that the rates of benefiting from the raw protein also increased the profits of the dry material in the fodder if 5 % whey was added into it [8].

The aim of this study is to determine whether a milk replacer composed by adding whey powder to cow milk could be an alternative to mother milk. For this purpose, weekly live weight gains of kids raised with the mother's milk or fed a milk replacer characterized by whey and cow milk. Besides, the variation of some blood parameters determined during a period of three months.

FIGURE 1
Powder produced from whey

FIGURE 2
Whey formed during cheese production

FIGURE 3
Destruction of the Nature!!! Whey is being released into the River Kars in Turkey without being processed

MATERIALS AND METHODS

Animals and experimental design. This research was conducted in the goat research unit of the Faculty of Agriculture, Adnan Menderes University (Turkey). Twenty three healthy Saanen kids of the same ages (one week old) were used in the study. Twin and triplet kids were distributed equally into two groups by taking the gender factor into account as well. Kids were allotted into two groups: a Control group (CG) containing 13 kids fed only mother milk and an Experimental Group (EG) containing 10 kids fed by milk replacer composed of whey powder (10 %), cow milk (75%) and water (15%). 10 kids in the EG (4 males and 6 females) were separated from their mothers at one week of age and were fed with milk replacer, and 13 kids in CG (5 males and 7 females) were kept with their mothers and fed mother's milk. While formulating milk replacer, both the prices of goat and cow milk and the nutritional requirements of the kids were taken into consideration. Milk replacer was given as much as 10% of the kids' live weights two times daily, in the morning at 9 am and in the evening at 5 pm. When the kids reached 2 months of age, they were weaned. During the study, the EG animals were taken into individual pens. On the other hand, the CG animals were kept pens together with their mothers (one mother and its kids per pen) and they were let to suck their mothers. During this period, the goats that were kept with their kids were not milked. Live weight of kids were recorded weekly. Samples of blood were collected from each animal at the beginning of the trial, and end of the trial by punching the jugular vein. Blood was stored into tubes without anticoagulant and serum was immediately separated by centrifugation (5000 x g for 30 min at 25°C).

The serum levels of glucose and urea were determined using commercial assay kits (Archem Diagnostics, Turkey) with an automated analyzer "Chemray 120, Rayto".

Statistical analysis. The general linear model in Equation 1 was applied for the statistical analysis of live body weight, glucose and urea data:

$$y_{ijk} = \mu + \alpha_i + \tau_j + (\alpha\tau)_{ij} + \beta_1(X_{1ijk} - \overline{X}_1) + e_{ijk} \quad (1)$$

where $y_{ij(k)}$ is the response variable for live body weight, glucose or urea measured at the end of the experiment; μ is the overall mean; α_i is the ith gender effect (i=male, female); τ_j is the jth group effect (j=experiment, control); $(\alpha\tau)_{ij}$ is the interaction between gender and group; β_1 is the regression coefficients of body weight, glucose or urea (X_1) at the beginning of the experiment; $\overline{X}_1$ is the averages of body weight, glucose or urea (X_1) at the beginning of the experiment and $e_{ij(k)}$ is the normally distributed random error.

After significant effects of model factors were identified, differences between least square means of factor levels were considered significant at $p<0.05$ (2-tailed) based on the Tukey adjustment type I error rate. All of the analyses were carried out by the statistical software program SPSS 22 for Windows, 2013.

RESULTS AND DISCUSSION

In this study, it was aimed to determine whether the dairy replacement feed which was composed by adding whey powder to cow milk could be an alternative to mother milk in kid nourishment. The average weekly live weight gains of the kids in CG and EG were recorded for two months after they got mouth milk and were compared. In this study, the live weight gains of the kids in both groups were similar to each other and the differences between the EG and CG were found statistically insignificant. While the starting average live weight of the kids in EG was 4.980 kg, their value in the last week was observed to have reached up to 11.41 kg, and the average live weight gain was totally 6.43 kg in the 8 weeks' period. However, the same value for the kids in CG was determined as 5.48 kg and as 10.95 kg in the last week. The average live weight gain in this group was 5.12 kg in the 8 weeks period. The averages of live weight gains reached at the end of the

period in both groups were similar to each other. When the males and females in both groups were compared, live weight gains of the both gender groups were found close to each other and the difference between them was found statistically insignificant (Table 1).

In the statistical analyses conducted, the effect of the starting live weights of the kids in both groups included in the model as covariates was found statistically significant, but the effect of gender was found to be insignificant.

Glucose and Urea Levels in the Blood. The normal values of glucose and urea for small ruminants ranges between 80-120 mg/dl and 8-20 mg/dl, respectively [9].

The glucose values prior to the experiment were taken as covariates. The difference between EG and CG with regard to glucose levels and the effect of gender was found statistically insignificant. Table 2 shows that the glucose levels in the blood samples taken from the both groups are close to each other

Urea level differences according to gender and according to EG and CG were found insignificant. As a result of a general evaluation, while the average urea level in EG group was 20.54 mg/dl, it was 17.41 mg/dl in CG, both of which within usual ranges (Table 3) Although the difference between the groups were found statistically insignificant, the urea amount in the EG was observed to be a little higher than in the CG.

This result indicates that the nutritional requirements of the kids particularly nourished with milk replacer could be enough (Table 1 and Table2).

Under the perspective of the studies conducted in the recent years, methods of rearing kids have been tried to be improved depending on the kids' sanitary conditions and the benefits of the enterprises. Particularly the artificial rearing method, which has occupied an application opportunity among kid nourishment methods, has gained a significant concern in rearing animals to meet the increasing demand for the goat milk [10-13].

In a study observing the body weights of kids in 5 groups fed on goat milk, cow milk, lamb milk replacer, calf milk replacer and kid milk replacer in 60 days period, the results were 14.12, 13.80, 13.72, 12.73 and 13.41 kg, respectively. When these results were examined in an economic point of view, it was determined that the cheapest feeding solution seemed as cow milk. [14]. In our study, though, the average live weights after a 56-day-nourishment period in two groups of kids that were fed on mother milk (CG) and milk replacement food (whey + cow milk + water) (EG) were found as 10.95 kg and 11.41 kg respectively. While the starting average live weight of the kids nourished with the milk replacer (EG) was 4.98 kg, the starting nourishment weight of the control group was 5.48 kg. This difference between the two groups was not found statistically significant. Furthermore, the kids in the CG were kept freely with their mothers continuously, but the kids in the EG were given the milk replacer twice a day. Commercial milk replacers formulated for calves and lambs are preferred as they result in successful weight gains. However, these replacers cannot provide an economic rearing for goat kids. Recently, more alternative researches have been carried on goat milk replacer formulations to secure more economical rearing [15,16].

TABLE 1
Live body weight as affected by gender and group

	Groups		
Gender	Experimental -1	Control – 2	Mean of Gender
Male - 1	12.02 ± 1.06	11.55 ± 0.85	11.77 ± 0.66
Female - 2	10.79 ± 0.73	10.38 ± 0.68	10.59 ± 0.50
Mean of Groups	11.41 ± 0.65	10.95 ± 0.54	11.18 ± 0.41

TABLE 2
Glucose as affected by gender and group

	Groups		
Gender	Experimental -1	Control – 2	Mean of Gender
Male - 1	71.54 ± 6.38	82.41 ± 5.56	76.97 ± 4.21
Female - 2	66.88 ± 5.52	77.32 ± 4.18	72.10 ± 3.45
Mean of Groups	69.21 ± 4.21	79.86 ± 3.46	74.54 ± 2.72

TABLE 3
Urea as affected by gender and group

	Groups		
Gender	Experimental -1	Control – 2	Mean of Gender
Male - 1	22.14 ± 5.34	20.05 ± 4.59	21.07 ± 3.53
Female - 2	18.99 ± 4.71	14.805 ± 3.63	16.87 ± 2.87
Mean of Groups	20.54 ± 3.62	17.405 ± 2.90	18.97 ± 2.28

In a study conducted, a formulation composed of whey at a rate of 29 %, dehydrated cow milk at a rate of 14%, and some other oils at various rates was experimented in rearing kids. The results were compared to the results obtained from commercial rearing formulation for calves, and the difference between the two milk replacers was found to be insignificant [15]. In our study, it was determined that a simple alternative rearing formulation composed of whey, cow milk and water could be an alternative milk replacer for kids. In the majority of the studies conducted on this issue, the milk replacer was given to kids as adlibutum [14-16]. In this study, though, the results obtained by feeding the kids with the milk replacer only twice a day -in the morning and evening- were compared to the results of the kids fed on mother milk continuously till weaning with regard to live weight gains, and the difference between these groups was found statistically insignificant.

According to the recorded energy and protein values, it could be said that growing and development could be better in CG; however, from the statistical point of view, there was not a statistically significant difference between the CG and the EG. For this reason, by taking the milk and whey prices into account, a convenient milk replacer could be composed and given to the kids 4 or 5 days after the birth instead of mother milk.

In another study conducted on kids of different genotype, it was found that the use of 35% whey with cow milk replacer allows a profitable rearing of kids; while 20% or 50% whey in the mixture showed poorer results [2]. In this study, 10% whey and 15% water were added into cow milk as the milk replacer. No significant differences were determined between the EG kids and the CG kids in their weekly live weight gains and in their total live weights after 8 weeks age. In this study, the most profitable and the most convenient amounts for the mixture to be the milk replacer were arranged as 10 % whey, 75 % cow milk and 15 % water. In the study conducted by Galina et al [2], the best whey ratio to add into the cow milk was determined as 35%. However, in the study by Tacchini et al [15], which was mentioned above, whey was used at a different rate as 29 % in another formulization. Since whey prices might change according to the regions, this high whey ratio may not provide the desired benefits due to the different conditions in different regions and countries. For this reason, the amount of the whey to be added into the cow milk in artificial rearing should be arranged according to the milk and whey prices in the regions where the farms are located. Under the light of these studies, it could be claimed that the kids could be nourished with the food prepared by adding whey into cow milk instead of using the mother goat milk, which could be marketed in much more profitable ways. At the end of this study, which was conducted to determine a profitable formula for goat milk replacer, it was understood that a simple alternative rearing formulation composed of whey, cow milk and water would be a convenient milk replacer for kids until weaning period.

CONCLUSIONS

According to the results obtained from the study, the whey powder as an ingredient of milk replacer formulation could be a better solution either economical or environmental perspective. It is obvious from the study results that no significance among kid's performances while artificial rearing with milk replacers and it is a promising solution for the future. Milk replacer used in this study -based on the cow milk and whey powder- is recommended for dairy goat farms where the goat's milk is marketed in higher prices or processed in dairy industry. In this way, both environmentally harmful by-product "whey" will add-value to milk replacer formulations and dairy goat enterprisers will be more profitable.

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