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Effect of whey and propolis on growth characteristics, on blood values and diarrhea of the goat kids

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ABSTRACT

This study was conducted to obtain an alternative, more economical and healthier milk substitute feed by adding whey powder and propolis to cow's milk in goat kid rearing. Forty Saanen goat kids born in the same period were divided into 4 groups, 7 days after their birth. The kids were divided into 4 groups of 10, with 10 in the control group (CG) who were kept together with their mothers, and in experimental groups 1-2-3 (EG1, EG2, EG3) who were kept in separate sections. Kids in all three experimental groups were fed with only the milk substitute (cow's milk+whey powder+water). In groups EG2 and EG3, the kids were given 0. 4 cc and 0. 2 cc propolis respectively in addition to the milk substitute once a day. The growth and development parameters and rectal temperatures of the kids were measured once a week, and morning and evening diarrhea scorings were taken in all groups. Biochemical and hematological analyses were performed. According to all the results obtained, the differences in body temperatures and in the glucose and urea values between the groups were found to be significant ($P<0.05$). Each group was evaluated within itself, RBC analysis results were found to be significant in all groups. The insignificant difference between the average growth and development parameters of the kids in the EG and in the CG was an important finding in growing kids more economically and reserving goat's milk for more profitable procedures. According to the diarrhea scores, it was observed that propolis was effective against diarrhea, and it was concluded that it could be used in raising kids as a preventive measure. Feeding kids with the milk substitute was found to be more economical than feeding them with their mother's milk. As a result of this study, it could be suggested that the use of milk substitutes containing whey and propolis will positively affect the growth, development and health of goat kids.

Key Words: goat kids; whey; propolis; growth characteristics; blood values; diarrhea

Introduction

Artificial milk feeding is used on sheep and goat farms depending on the increase in the amount of marketable milk. Due to the high prices of goat's milk, various food formulations have been tried in artificial applications. Cow's milk and whey powder were used as a milk substitute feed for lamb and calf feeding because of their low cost and easy supply. GALINA et al. (1995) fed different genotype goat kids with cow's milk and different proportions (20-35-50%) of whey, and found that the live weights were statistically similar to those of offspring feeding from their mothers.

Mortality in the pre-weaning period in goat kids is a major problem. After birth, the process

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of formation of active immune elements begins in the offspring. Depending on the environmental conditions in this process and on the adaptation ability of the animal, it has been observed that offspring with low resistance die in the first month (KARSLI and EVCI, 2018). In the studies conducted, the mortality rates of goat kids vary between 2.2-14% in the first 5 days after birth and this rate increases even more on the 10th day and later on (HOLMØY and WAAGE, 2015; UNAL et al., 2018). During this adaptation period after birth, antibiotics were used in the past to decrease the mortality rate of the offspring, but this was prohibited due to the increase in pathogen resistance. The search for alternative feed additives to combat the negative effects of intestinal pathogens instead of antibiotics has increased in breeding with or without their mother. For this purpose, probiotics, prebiotics, organic acids and essential oils have recently been used commercially (UNLU et al., 2013; ZENG et al., 2015).

Propolis is a bee product that is effective in the formation of an aseptic environment in the hive due to its antimicrobial activity. It is collected by bees from various parts of plants and used for different purposes in the hive (BONAMIGO et al., 2017; KOCOT et al., 2018). It is known that propolis is effective against various bacteria (VELIKOVA et al., 2000; KATIRCIOĞLU and MERCAN, 2006), viruses (NERMEEN et al., 2021), fungi (MURAD et al., 2002) and molds (SILICI, 2005). In addition, it has been determined that propolis has an immunomodulatory effect on mammals (ONUR et al., 2018). There are many studies on its effects in poultry (DENLI et al., 2005; TEKELI et al., 2011; HAŠÈIK et al., 2012). In ruminants, many studies have been conducted to determine the effects of propolis on rumen digestive metabolism and reproduction (KUPCZYŃSKI et al., 2012; ZEEDAN and KOMONNA, 2013; KARA et al., 2014). Propolis supplementation causes significant differences in some hematological values in Hanwoo calves (SARKER and YANG, 2010). ZEEDAN and KOMONNA, (2013) found that propolis supplementation to buffalo cows positively affected feed utilization, reproductive performance, milk yield, offspring birth weight and offspring immunity. In addition, it was found that the addition of propolis extract to calves as an anti-diarrhea agent reduced diarrhea symptoms in calves and increased live weight (CHUDOBA et al., 2003). Propolis supplementation improved efficiency, oxidative status and immune response in barki sheep and lambs (SHEDEED et al,. 2019). In addition, it was determined that propolis supplementation increased body weight in Ivesi sheep (AL-KHAFAJI, 2016). Knowing the physiological reference values of the blood of goat kids is important in terms of providing useful information for recognizing the animal's adaptation mechanisms against the environment during the first month of their lives, and for diagnosing the diseases they experience (ZUMBO et al., 2011). In sheep and goat breeding, the emergence of the self-immunity of new born kids and lambs, and their adaptation to the environment take place during a critical period that may involve severe kid and lamb losses. In this period, knowing certain age-related hematological reference intervals of lambs and goats helps to evaluate their care, nutrition and health status in a realistic way (ABDOLVAHABI et al., 2018). It is also known that age has a significant effect on hematological values (ABDOLVAHABİ et al., 2018). Although there are many studies on the hematological values of most farm animals, there are few studies on goat-kid hematology, and there are very few studies on age-related hematological changes in Saanen goats on the basis of breed (ZUMBO et al., 2011; ABDOLVAHABI et al., 2018).

The aim of this study was to investigate an alternative, more economical and preferable milk substitute feed by adding whey to cow's milk, and to determine the effect of propolis supplementation on some growth development parameters and the blood values of goats.

Materials and methods

This study was carried out at the Goat Breeding Unit of Aydın Adnan Menderes University, Faculty of Agriculture Animal Research and Application Center. The coordinates of the enterprise are: 37 ° 45′03.31 ′ ′ N and 27 ° 45′27.16 ′ ′ E, 52 m above sea level. A Mediterranean climate prevails in the

region. Environmental temperature and humidity measurement were determined by a Hobo device, with daily ambient temperature (°C), and relative humidity (RH, %). The mean temperature-humidity index (THI) was calculated according to the equation: {(0.31 − 0.31 RH/100) (db °C − 14. 4)} (MARAI et al., 2007). The site where the experiment was conducted is 52 m above sea level and in a region with a Mediterranean climate and the temperature difference between day and night is high. During the experiment, the lowest temperature was 1° C and the highest temperature was 27° C. The average humidity varied between 57 and 68%. The temperature humidity index was found to be between 10.58 and 16.72.

The animals in the study consisted of 40 kids born in the same period from 40 synchronized goats. Forty Saanen goat kids born in the same period were divided into 4 groups 7 days after their birth. The Control Group, CG (n=10) was kept free with their mothers and were freely suckled by their mothers. The first experimental group of kids -EG1- (n=10) were fed with only the milk substitute (75% cow's milk + 10% whey powder + 15% water), the second experimental group kids-EG2-were given the milk substitute and 0.4 cc propolis and the third experimental group kids-EG3-were given the milk substitute and 0.2 cc propolis.

The kids in the control group stayed together with their mothers in a semi-open shelter of about 30 square meters and were freely suckled by their mothers. The mothers of the kids in the control group were not milked during the trial. The kids in the EG1, EG2 and EG3 groups were separated from their mothers and placed in individual 1.5x1.5 m semi-open, chambers. The kids in all experimental groups were bottle fed individually twice a day with the milk substitute at body-temperature, made by mixing 75% cow's milk + 10% whey powder + 15% water. Lactopro brand whey (oil <1. 5%, lactose> 5%, protein 7-10%, lactic acid<15%, Ph 6-6.2%, salt <2.20%, Ash <5%, solubility 98%, moisture <2%) was used in the milk substitute feed. The amount of the milk substitute given to the kids was equal to 10% of the live weight of each kid, and it was increased in parallel with the live weight increase. In addition, 0. 4 and 0. 2 cc ethanolic propolis extract was given orally to the kids in groups EG2 and EG3, respectively, once a day with an injector. Propolis extracts were obtained from the company İdapolis from Canakkale 18, Mart University Technopark. The amount of feed consumed daily was noted for each kid. In the third week of the experiment, 100 g of good quality dried clover was placed in front of each animal. During the 4th week, 100 g starter feed, containing 20% crude protein and 2700 kcal / kg metabolic energy, was placed in front of each animal. In order to determine the feed consumption of the kids, the remaining feed was weighed every week and recorded weekly. The amount of feed was increased in a controlled manner in line with the increase in live weight. In the study, clean water was kept in front of the kids starting from their second week.

Live Weights, BCS, body measurements and diarrhea scoring (DS). The kids were weighed individually every week from birth, and their live weights (LW) were determined. The kids were kept hungry in the morning before weighing. Body condition score (BCS) was recorded after weighing. The BCS were used with scores range from 1 (very poor condition) to 5 (very good condition) with half-unit increments (RUSSELL et al., 1969). This BCS method is effective and easy to apply in small animals of any age, making it preferable.

The body length (BL), height of withers (HW) and chest circumference (CC) measurements were taken by stick and tape on a flat concrete floor. The rectal body temperature of the kids was measured every week with a digital thermometer. The daily health condition of the animals was observed every day. Stools were checked twice a day, in the morning and evening, and diarrhea scores were recorded using the stool consistency scaling system. The scoring ranges between 1 and 4 (1 = watery; 2 = fluid; 3 = soft; 4 = normal) (AYIŞIĞI et al., 2005).

Blood sampling and hematological analysis. Blood samples were taken from animals in all the groups in total three times throughout the study, on the first day when the goat kids were grouped, in the middle period of the experiment (15th day) and at the end of the experiment. (30th day). Blood

samples were taken from the jugular vein in the neck (vena jugularis), of approximately 10 ml, and were placed into EDTA tubes (ethylenediamine tetra acetic acid) for hematological analysis, and into heparin tubes for biochemical analysis. Hemogram values were analyzed using a Horiba Medical ABX Micros ABX brand device.

Statistical Analysis

Statistical analysis of the features specified in the study was performed using the linear model equation defined below:

$$y_{ijkl} = \mu + \alpha_i + \tau_j + (\alpha\tau)_{ij} + \delta_k + e_{ijkl}.$$

Where: y_{ijkl}: observation of individual l, on day j, in group i, and gender k; μ: overall mean; α_i: the effect of group i (i: EG1, EG2, EG3 and CG); τ_j: the effect of day j (j: 1, 8, 15, 22, 29, 36); $(\alpha\tau)_{ij}$: the interaction of group and day effects; δ_k: the effect gender k (k: Male and Female) and e_{ijkl}: random error term. The linear model equation described above was applied to the analysis of the data using the nlme (Linear and Nonlinear Mixed Effects Models) package (PINHEIRO et al. 2013) defined in the R-packet (R Core Team) program with Ω variance-covariance error matrix. The unstructured variance-covariance structure was determined using Schwarz›s Bayesian Criterion (LITTELL et al., 1997). After estimation of variances and covariances in the Ω matrix, it was determined whether the factors in the linear model equation were statistically significant using the F-test. The significance of the differences between the levels of statistically significant factors was determined by applying the Tukey test at the level of significance of $P<0.05$.

Results

Live Weights, BCS and Body Measurements. There was no difference between the groups in terms of live weight (LW) during the experiment period.

In relation to BCS in the groups, at the third and fourth measurements, the difference between EG3 and CG was found to be statistically significant ($P<0.05$). When we evaluated the groups within themselves, the difference between the means was found to be insignificant in all groups except the control group.

Table 1. Least squares means and standard errors of the kids' LW, BCS, BL, WH and CC

		1st day	8th day	15 th day	22 th day	29 th day	36 th day	P
LW (kg)	EG1	4.59±0.36^{a}	4.92±0.41^{a}	5.5 ±0.47^{b}	6.43±0.52^{c}	7.58±0.59^{d}	8.68±0.61^{e}	*
	EG2	4.62±0.36^{a}	4.89±0.41^{a}	5.45±0.47^{b}	6.36±0.52^{c}	7.67±0.59^{d}	8.71±0.61^{e}	*
	EG3	4.57±0.36^{a}	4.81±0.41^{a}	5.46±0.47^{b}	6.43±0.52^{c}	7.66±0.60^{d}	8.67±0.62^{e}	*
	CG	4.57±0.36^{a}	5.62±0.41^{b}	6.97±0.47^{c}	8.17±0.52^{d}	9.32±0.59^{e}	9.86±0.61^{f}	*
	P	IN	IN	IN	IN	IN	IN	
BCS	EG1	1.74±0.09^{a}	1.72±0.09^{a}	1.92±0.14^{aAB}	1.87±0.12^{aAB}	1.67±0.10^{a}	1.74±0.08^{a}	IN
	EG2	1.79±0.09^{a}	1.79±0.09^{a}	1.94±0.14^{aAB}	1.92±0.12^{aAB}	1.97±0.10^{a}	1.84±0.08^{a}	IN
	EG3	1.69±0.09^{a}	1.74±0.09^{a}	1.83±0.14^{aA}	1.72±0.12^{aA}	1.91±0.10^{a}	1.74±0.09^{a}	IN
	CG	1.87±0.09^{ac}	2.04±0.09^{ad}	2.37±0.14^{bB}	2.24±0.12^{bB}	1.94±0.10^{ad}	1.67±0.08^{c}	*
	P	IN	IN	*	*	IN	IN	
BL (cm)	EG1	37.5±1.04^{a}	40.2±1.13^{b}	41.5±1.09^{c}	42.8±1.08^{c}	43.9±1.04^{d}	44.4±1.05^{d}	*
	EG2	37.1±1.04^{a}	39.9±1.13^{b}	41.1±1.09^{c}	41.8±1.08^{c}	44.0±1.04^{d}	45.0±1.05^{e}	*
	EG3	37.4±1.04^{a}	39.2±1.13^{b}	41.2±1.10^{c}	43.1±1.09^{d}	44.7±1.05^{e}	46.1±1.06^{f}	*
	CG	38.0±1.04^{a}	40.7±1.13^{b}	42.6±1.09^{c}	44.9±1.08^{d}	46.2±1.04^{e}	46.7±1.05^{e}	*
	P	IN	IN	IN	IN	IN	IN	

Table 1. Least squares means and standard errors of the kids' LW, BCS, BL, WH and CC (continued)

		1st day	8th day	15 th day	22 th day	29 th day	36 th day	P
WH (cm)	EG1	33.8±0.82^{a}	36.0±0.98^{b}	38.7±0.90^{c}	40.8±0.98^{d}	42.5±1.09^{e}	43.8±1.09^{f}	*
	EG2	33.6±0.82^{a}	36.7±0.98^{b}	38.8±0.90^{c}	40.1±0.98^{d}	42.3±1.09^{e}	43.9±1.09^{f}	*
	EG3	34.4±0.82^{a}	36.2±0.98^{b}	39.0±0.91^{c}	40.6±1.00^{d}	42.5±1.11^{e}	43.8±1.10^{f}	*
	CG	33.9±0.82^{a}	36.4±0.98^{b}	38.2±0.90^{c}	40.6±0.98^{d}	43.0±1.09^{e}	43.7±1.09^{e}	*
	P	IN	IN	IN	IN	IN	IN	
CC (cm)	EG1	37.8±1.19^{a}	39.1±1.15^{b}	40.8±1.13^{c}	42.8±1.11^{d}	44.9±1.19^{e}	46.5±1.13^{e}	*
	EG2	37.3±1.19^{a}	38.7±1.15^{b}	40.3±1.13^{c}	42.2±1.11^{d}	45.0±1.19^{e}	47.0±1.13^{f}	*
	EG3	37.8±1.19^{a}	38.3±1.15^{a}	40.9±1.14^{b}	42.6±1.12^{c}	45.1±1.21^{d}	46.7±1.14^{d}	*
	CG	37.5±1.19^{a}	40.7±1.15^{b}	42.9±1.13^{c}	44.7±1.11^{d}	45.7±1.19^{d}	48.0±1.13^{e}	*
	P	IN	IN	IN	IN	IN	IN	

Live weight :(LW), Body condition score (BCS), Body length: (BL), Height of Withers (WH), Chest Circumference (CC)
^{a,b,c,}…: Differences between averages with different letters on the same line were statistically significant (*P<0.05). IN; insignificant
^{A,B,C}...: Differences between means with different letters in the same column were statistically significant (P<0.05).

There was no difference between the groups in terms of body length (BL) averages during the study period. Within the groups, the differences were statistically significant in terms of the BL averages in each group during the study period (P<0.05). In group 1, the means of the first, second, third, fourth and sixth measurements were significantly different (P<0.05), but the means of the fifth and fourth and sixth measurements were not significantly different. In the first 3 measurements in all groups, it was observed that the BL averages were statistically different from each other. Only in EG3 were statistically significantly different values determined between all measurement averages (P<0.05). According to the first BL measurements, it was seen that EG3 had the same BL as the CG at the last measurement, while the CG had the highest value (Table 1).

The differences between the average BL values at the first measurement and the last measurement, of the kids in EG1, EG2, EG3 and CG were 6.9, 7.9, 8.7 and 8.7 cm, respectively. There was no difference between EG3 and CG, and it was observed that their BL increased at the same rate. In addition, between the 5th and 6th measurements, it was seen that the animals in CG changed very little in terms of BL and it remained almost constant. However, it was seen that the increases continued at higher levels in EG2 and EG3 who were given milk substitute and propolis at different doses.

When a comparison between the groups was made, there was no statistically significant difference in terms of height of withers (WH) during the study period. When comparisons within each group were made, it was seen that the difference between the measurement averages in all weeks was statistically significant (P<0.05). All the measurements of the CG, except for the last two measurements, were found to be statistically different from each other (P<0.05). In terms of the first measurement values, it was seen that EG2 had the lowest WH (33.6 cm), but the highest value (43.9 cm) at the last measurements. At the end of the experiment, it was observed that all three experimental groups fed with the milk substitute had almost equal wither height to the CG that were continuously suckled by their mothers (Table 1).

In the comparison between the groups, there was no statistically significant difference in terms of chest circumference (CC) during the experiment. The differences were statistically significant (P<0.05) between the average measurements of EG1, EG2, EG3 and CG in all weeks and it was determined that CC was only statistically different at each measurement in all weeks in EG2 (P<0.05).

In EG1, the difference between the mean (CC) in the first five measurements was found to be statistically significant, but the difference between the averages at the 5th and 6th weeks was insignificant. In the control group, the differences

between the 1st, 2nd, 3rd, 4th and 6th week CC measurements were found to be statistically significant; however, the differences between the measurements in the 4th and 5th weeks were found to be insignificant. At the end of the experiment, the highest CC measurement, at 48 cm, was in the control group. While EG2 was the second with 47 cm, EG3 was third with 46.7 cm and EG1 was last with 46.5 cm (Table 1).

In terms of the mean body temperature (BT) values in the groups, the difference between the third and sixth measurement values was statistically significant (P<0.05). When in-group comparisons were made, it was seen that the difference between the average body temperatures measured in all weeks in the control group was statistically insignificant. However, the in-group differences in the EG groups were found to be statistically significant (P<0.05).

Table 2. Least squares means and standard errors of the kids' BT (°C)

	1st day	8th day	15 th day	22 th day	29 th day	36 th day	P
EG1	39.53±0.09^{ab}	39.47±0.09^{ab}	39.54±0.06^{aA}	39.64±0.08^{a}	39.47±0.10^{ab}	39.24±0.06^{bA}	*
EG2	39.78±0.09^{a}	39.29±0.09^{bc}	39.23±0.06^{bB}	39.77±0.08^{a}	39.46±0.10^{abc}	39.45±0.06^{cAB}	*
EG3	39.75±0.09^{a}	39.41±0.09^{b}	39.29±0,07^{abB}	39.62±0.09^{ab}	39.41±0.10^{ab}	39.30±0.06^{bA}	*
CG	39.77±0.09^{a}	39.48±0.09^{a}	39.47±0.06^{aAB}	39.61±0.08^{a}	39.54±0.10^{a}	39.53±0.06^{aB}	IN
P	IN	IN	*	IN	IN	*	

^{a,b,c,}…: Differences between averages with different letters on the same line were statistically significant (P<0.05). IN; insignificant
^{A,B,}… :Differences between means with different letters in the same column were statistically significant (P<0.05).

Glucose, Urea and hematological analysis. There was no statistical difference between the groups in the glucose levels in the blood samples collected at the beginning and at the end of the experiment. Moreover, the means of the second analysis indicated that the difference between the groups was statistically significant (P<0.05). In the comparison of the groups, the difference between EG2 and EG3 was statistically insignificant in the second analysis, while the differences between EG3 and CG and EG1were found to be statistically significant (Table 2). In the in-group evaluation, there was no significant difference in CG, EG1 or EG2. In EG3, a significant difference was found between the baseline and the final analysis and middle analysis (P<0.05).

Table 3. Least squares means and standard errors of the kids' Urea(mg/Dl)

		The first analysis (1th day of the experiment)	The second analysis (15th day of the experiment)	The last analysis (30th day of the experiment)	P
Glucose	EG1	115.7 ± 3.97^{a}	99.4 ± 8.26^{Aa}	105.8 ± 3.50^{a}	IN
	EG2	108.2 ± 3.97^{a}	111.8 ± 8.26^{ABa}	105.8 ± 3.50^{a}	IN.
	EG3	104.0 ± 3.97^{a}	142.5 ± 8.70^{Bb}	113.6 ± 3.67^{a}	*
	CG	108.8 ± 3.97^{a}	107.4 ± 8.26^{Aa}	103.6 ± 3.50^{a}	IN
	P	IN	*	IN	
urea	EG1	14.9 ± 1.33^{a}	11.2 ± 1.15^{a}	14.0 ± 1.43^{Aa}	IN
	EG2	14.4 ± 1.33^{a}	12.9 ± 1.15^{a}	14.1 ± 1.43^{Aa}	IN
	EG3	13.7 ± 1.33^{a}	11.6 ± 1.21^{a}	13.1 ± 1.51^{Aa}	IN
	CG	12.8 ± 1.33^{a}	15.0 ± 1.15^{a}	20.6 ± 1.43^{Bb}	*
	P	IN	IN	*	

^{a,b,c,}…: Differences between averages with different letters on the same line were statistically significant (P<0.05). IN: insignificant
^{A,B,}... :Differences between means with different letters in the same column were statistically significant (P<0.05).

It was observed that there was no statistically significant difference between the groups in terms of mean blood urea count obtained in the first and second blood analyses. Moreover, the difference between the groups in the mean blood urea count obtained from the last analysis was found to be insignificant for EG1, 2 and 3, but significant for CG ($P < 0.05$). In the evaluation within the groups, the difference between the three periods analysis was found to be statistically significant in CG ($P < 0.05$).

Table 4. Least squares means and standard errors of some of the kids' hematological values

		The first analysis (1th day of the experiment)	The second analysis 15th day of the experiment	The last analysis 30th day of the experiment	P
RBC (1012/µL)	EG1	6.31 ± 0.332^{a}	7.26 ± 0.266^{b}	8.64 ± 0.266^{c}	*
	EG2	6.79 ± 0.340^{a}	7.70 ± 0.262^{b}	8.63 ± 0.262^{b}	*
	EG3	6.33 ± 0.340^{a}	6.67 ± 0.275^{a}	8.64 ± 0.275^{b}	*
	CG	6.98 ± 0.332^{a}	7.36 ± 0.266^{a}	8.83 ± 0.266^{b}	*
		IN	IN	IN	
HGB (g/dL)	EG1	7.61 ± 0.362^{a}	8.17 ± 0.235^{a}	8.44 ± 0.297^{a}	IN
	EG2	8.17 ± 0.372^{a}	8.15 ± 0.234^{a}	8.36 ± 0.295^{a}	IN
	EG3	7.78 ± 0.373^{a}	7.77 ± 0.240^{a}	8.33 ± 0.309^{a}	IN.
	CG	8.26 ± 0.362^{a}	7.54 ± 0.235^{b}	8.23 ± 0.297^{ab}	*
		IN	IN	IN	
HTC (%)	EG1	23.1 ± 1.390^{a}	24.1 ± 0.924^{a}	24.7 ± 0.919^{a}	IN.
	EG2	25.5 ± 1.409^{a}	24.0 ± 0.903^{a}	25.1 ± 0.898^{a}	IN.
	EG3	24.0 ± 1.410^{a}	23.2 ± 0.927^{a}	25.1 ± 0.942^{a}	IN.
	CG	26.2 ± 1.390^{a}	23.1 ± 0.924^{b}	24.6 ± 0.919^{ab}	*
		IN	IN	IN	
MCH (pg)	EG1	13.4 ± 0.436^{ab}	12.6 ± 0.685^{a}	14.3 ± 0.755^{b}	*
	EG2	13.8 ± 0.446^{a}	13.4 ± 0.683^{a}	13.5 ± 0.753^{a}	IN
	EG3	13.8 ± 0.446^{ab}	12.9 ± 0.703^{a}	15.2 ± 0.789^{b}	*
	CG	13.3 ± 0.436^{a}	11.6 ± 0.685^{b}	13.9 ± 0.755^{a}	*
		IN	IN	IN	
LYM (%)	EG1	50.3 ± 2.83^{a}	49.2 ± 2.45^{a}	43.0 ± 3.18^{a}	IN
	EG2	54.4 ± 2.93^{a}	47.2 ± 2.44^{b}	44.9 ± 3.16^{b}	*
	EG3	49.7 ± 2.93^{a}	46.2 ± 2.52^{a}	42.7 ± 3.32^{a}	IN
	CG	53.5 ± 2.83^{a}	46.9 ± 2.45^{b}	38.2 ± 3.18^{c}	*
		IN	IN	IN	
MON (%)	EG1	3.79 ± 1.119^{a}	3.85 ± 0.463^{a}	6.00 ± 0.948^{a}	IN
	EG2	4.22 ± 1.174^{a}	4.73 ± 0.462^{a}	4.79 ± 0.948^{a}	IN
	EG3	5.41 ± 1.174^{a}	3.43 ± 0.485^{a}	5.94 ± 0.996^{a}	IN
	CG	3.60 ± 1.119^{a}	3.65 ± 0.463^{a}	8.32 ± 0.948^{b}	*
		IN	IN	IN	
GRA (%)	EG1	45.8 ± 2.65^{a}	46.9 ± 2.46^{a}	51.0 ± 2.53^{a}	IN
	EG2	41.6 ± 2.74^{a}	46.1 ± 2.44^{ab}	50.1 ± 2.51^{b}	*
	EG3	44.7 ± 2.74^{a}	51.7 ± 2.53^{b}	50.3 ± 2.63^{ab}	*
	CG	41.8 ± 2.65^{a}	49.6 ± 2.46^{b}	53.4 ± 2.53^{b}	*
		IN	IN	IN	

a,b,c,…: Differences between averages with different letters on the same line were statistically significant ($P<0.05$). IN: insignificant

When each group was evaluated within itself, RBC analyses results were found to be statistically significant in all groups. However, for EG1, the differences between the RBC averages in blood samples taken in all three analyses were found to be significant ($P<0.05$). After the first analysis, there was a continuous increase in RBC averages in all groups (Table 4).

The difference between the blood HGB (g/dL) rates between the groups was found to be statistically insignificant. In the within-group evaluation, only the difference between the mean HGB values in the first and second analysis was found to be significant in the CG ($P<0.05$). Also, there was a decrease in the second analysis of the control group compared to the first analysis (Table 4).

In this study, there was no statistically significant difference between the groups in terms of blood HCT rates. In the within-group evaluation, the difference between the mean HCT between the first and second analysis was found to be statistically significant in the control group ($P<0.05$). There was a steady increase in the HTC values only in EG1. In the other groups, there was first a decrease and then an increase (Table 4).

There was no significant difference between the groups in terms of MCH values. In the within-group evaluation, the differences between the analyses were found to be significant in all groups except for EG2 ($P<0.05$). While the values were quite stable in EG2, an increase was observed in the control group, EG3 and EG1 after the second analysis.

In terms of LYM%, the difference between groups was found to be insignificant. In the within-group evaluation, the differences between the analyses in the EG2 and CG in all three analysis periods were found to be statistically significant ($P<0.05$). While the difference between the first analysis and the second and third analyses was significant in the EG2, the difference was significant between the values in all three analyses in CG ($P<0.05$). In the second analysis, it was found that there was a greater decrease between the first and the second analyses in CG and the EG2 compared to the other groups. For EG1, EG2, EG3 and CG, the differences between the first analysis and the last analysis of LYM% were found to be 7.3, 9.5, 7, 15.3, respectively. The greatest decrease was seen in the CG (Table 4).

The differences between the groups in terms of Monocyte ratio (MON%) were statistically insignificant. However, in the within-group evaluation, the difference between the first and second analyses and the third analysis was found to be significant in the CG ($P<0.05$). A rapid rise was observed in the last analysis of the CG (Table 4).

The differences between groups were not found to be statistically significant for Granulocyte % (GRA) (Table 4). In the within-group evaluation, the differences between the mean values in all groups except EG1 were found to be statistically significant ($P<0.05$). The differences between the first and the last analyses were significant in EG2, while the differences between the first and the second analyses were significant in EG3 ($P<0.05$). In CG, the mean of the second and last analyses were similar, but the difference between the second and last analyses and the first analysis was found to be significant. In terms of GRA%, between the first and second analyses, it was observed that EG1 remained at a value close to the first value, with a slight increase, there was a slight increase in EG2 and EG3, and the highest increase was in CG. When the final analysis values were examined, it was seen that EG2 and EG3 were close to each other, and there was a slight decrease in the last analysis compared to the second analysis in EG3. In all the other groups, there was a gradual increase in all analyses (Table 4).

Diarrhea Scoring (DS). On separation of the kids from their mothers after the first week and upon introduction of the milk substitute with a bottle, it was observed that in all three groups there were kids with diarrhea every week. While diarrhea (1 = watery) was observed only twice in EG1 in the first week, all diarrhea scores increased in the following weeks. Especially in EG1 given the milk substitute (in the 3rd week), diarrhea increased by 1, 2, 3 points, and a slight decrease was observed in all three diarrhea points in the following weeks EG1 had the highest number diarrhea scores 1, 2, 3 which were observed 21, 19, 16 times, respectively, in the 5-week period. Therefore, the total number of cases of diarrhea observed in different severities in the first group was 56. EG1 had the highest

scores in terms of the total number of diarrhea observations and all three diarrhea scores (Table 5).

Table 5 Diarrhea Score (DS) observations by weeks

Weeks	Number of Diarrhea Score (DS) Observations								
	EG1			EG2			EG3		
	DS 1	DS 2	DS3	DS 1	DS 2	DS3	DS 1	DS 2	DS3
1	2			2	2	3	5	2	3
2	2	4	2	2		3	2		2
3	9	8	3	3	3	6	1	8	5
4	4	6	6	7	3	2		4	4
5	4	1	5	1	2	2	1		1
Total	21	19	16	15	10	16	9	14	15

EG2 and EG3 were the groups using the milk substitute + propolis. In the second week in EG2, no animals were seen with a diarrhea score of 2 and the amount of diarrhea was observed to decrease. In EG2, diarrhea scores 1, 2, 3 were seen 15, 10, 16 times respectively and in total 41 diarrhea cases were observed. In EG3, diarrhea points 1, 2, 3 and total diarrhea frequency during the 5 weeks were 9, 14, 15 and 38 times, respectively. In CG, 1 point diarrhea was observed only twice in the 4th week due to the effect of mother's milk.

Discussion

During our study, the average temperature humidity index was between 10.58% and 16.72%. According to the THI values found in our study, it was thought that there was no heat stress on the animals (MARAI et al., 2007). It was an important result of the study that there was no statistically significant difference between the body weight gains of the CG and the weight gains of the other three EGs fed with the milk substitute (Table 1). During the experiment, the kids were introducted to 400 cc of milk substitute per day, which was increased to a maximum of 1100 cc per day and gradually decreased when the kids started to take the milk substitute. It was suggested as a result of a study similar to this study, that goat kids should be nourished with a milk substitute by adding whey powder into cow milk instead of using the mother's milk, which could be marketed in much more profitable ways (AKCAY et al., 2021).

In some studies conducted, it was determined that propolis supplementation caused a significant increase in the live weights of calves and lambs (GUBICZA and MOLNAR, 1987; ITAVO et al., 2011). However, there are too few studies on the use of propolis during the nursing period in kids. In a study conducted on Nubian goats in Egypt, they reported that 0.6 ml of propolis supplementation positively affected the body weight gain (SADEK et al., 2020). In this study, the difference between the average live weights of kids in all groups was found to be insignificant. In some studies, it has been reported that propolis is more effective with rumen development in terms of live weight gain (MORSY et al., 2011). This study was carried out on goat kids whose rumens were not yet developed. Regardless of this, no statistically significant differences were found between the CG and the EGs. In our study, the highest BCS value at the end was found in the group fed with the milk substitute with +0.4 cc propolis.

There was no significant difference between groups in terms of body measurements. However, the groups given propolis were found to be larger than the group that consumed only milk substitute. At the end of the study, the highest body length value belonged to the CG. EG3, which was fed with milk substitute + 0.2 cc of propolis, was

second, and the third was EG2, which consumed milk substitute + 0.4 cc of propolis Last of all was EG1 that was only fed the milk substitute.

At the end of the experiment, average body temperatures were 39.53 ° C in CG, 39.45 ° C in EG2, 39.30 ° C in EG3 and 39.24 ° C in EG1. All measurement values were also close to literature values (HELAL et al. 2010). On the 15th day, the differences between the body temperatures of the kids in EG1, EG2 and EG3 were found to be significant ($P<0.05$). On the 36th day, the differences between EG2 and EG1 and EG3 were found to be statistically significant ($P<0.05$). These differences were important because changes in body temperature are an important indicator of the animals' ability to adapt to the environment, their health status, and their defense mechanisms against infections (EVANS et al., 2015; BERIHULAY et al., 2019). In addition, the body temperature of goats changes according to the seasons (MINKA and AYO, 2016).

A significant difference was found between the group averages in terms of glucose values measured on the 15th day of the experiment. The highest glucose value was 142.5 mg / dL in the EG3. This was followed by 111.8 mg / dL in EG2. It was an important result of the study that the glucose levels in EG2 and EG3 were higher than in CG and EG1 which was fed only the milk substitute. Again, in the last analysis, EG3 was the group with the highest glucose levels. ELITOK (2012) in their study found a glucose value of 42.34 mg / dL in 1 month old Saanen goats. In this study, glucose values in all groups were much higher than this value and almost twice as high.

Although the normal values of urea in blood in goats range between 4-80 mg / dL in general, the average value is given as 25 mg/dL (MBASSA and POULSEN, 1991). All urea values in our study were found to be in this range. In the first two analyses, no difference was observed between the groups, and in the final analysis, the urea values of the milk substitute-fed groups were found to be significantly lower than the CG values. This high urea value in the CG indicated that the kids in this group consumed too much mother milk unnecessarily (BENDELJA LJOLJİĆ et al., 2020). ELITOK et al. (2012) found an average urea value of 18.31 mg / dL in 1-month-old Saanen kids. All the groups in our study were close to these values and within the specified reference range.

The altitude of the region may affect some hematological values in goat kids. The RBC and HGB ratios of Saanen goats raised in a high altitude region in Turkey were found to be higher than the RBC and HGB ratios in all groups in this study (ELITOK, 2012). In a study conducted in Egypt, it was observed that the HGB rates in kids who were given propolis twice a week in different doses and in nanopathic form during the suckling period, varied between 13 and 23 (g/dL) (SADEK et al., 2020). In this study, it was seen that the group with the most stable HGB rates for all three analyses was EG2.

In this study, the differences between % HCT rates by week were only found to be significant in CG. It was determined that the progressive analysis values were lower (24. 6%) compared to the first analysis of HCT (26.2%) in CG. This decrease was thought to be due to the kids consuming too much milk (JOERLING and DOLL, 2019). At the end of the experiment, the highest hematocrit level (25.1%) was found in EG2 and EG3, that is, the propolis + the milk substitute groups.

The hematocrit value was found to be 29.4% in West African Dwarf Goats (DARAMOLA et al., 2005), 33.83% in Saanen goats and 23.40% in hair goats TURKYILMAZ (2003). It was seen in our study that feeding kids with food containing whey in the early period did not cause any anemia problems. In addition, it was also important that the highest HTC rate was in the groups given propolis in the last analysis.

In this study, the MCH values obtained for all groups were found to be quite high compared to studies conducted in different breeds and in different regions. (ZUMBO et al., 2011; ELIITOK, 2012; HABIBU et al., 2017).

When evaluated in general, it was important that there was a gradual decrease in LYM% rates in all groups in this study. The decreases in EG2 and in CG were found to be statistically significant. The initial LYM% values for EG2 and CG were 54.4 and 53.5, respectively. In the last

analysis, these values decreased to 44.9 and 38.2, respectively (Table 4). In another study in which propolis was given twice a week in different doses and nanoparticles, it was reported that the LYM% rates of goat kids varied between 34 and 40 during the suckling period. In the same study, LYM% was found to be 37 in the CG (SADEK et al., 2020). In Red Sokoto and Sahel kids, the highest and lowest LYM% values were found to be 54.36-59.54 and 59.17- 65.98, respectively, in different seasonal conditions (HABIBU et al., 2017).

The first analysis monocyte mean (3.79% and 3.60%) of EG1 and CG increased in the final analysis values (6% and 8.32%). These were the two groups with the highest increase of the groups. The monocyte mean values of the kids in the initial and final analyses in EG2 that were given 0.4 cc propolis were very close to each other (4.22% - 4.79%). In another study, monocyte ratios were found to vary between 4.66% and 5.66% for kids who were given propolis twice a week in different doses and nanoparticular form. In the same study, the monocyte value was found to be 5.0% in CG (SADEK et al., 2020).

It has been reported in some studies that propolis increases feed utilization and has a positive effect on rumen metabolism (OZTURK et al., 2010; MORSY et al., 2011; MORSY et al., 2015). In this study, this was the period when the goats could easily eat feed when they were 35-40 days old. In this period, the GRA values of the 2nd and 3rd groups, who were given propolis, were found to be lower than the other two groups (CG and EG1). In another study, it was demonstrated that different doses of propolis supplementation improved the productivity, oxidative status and immune response of Barki sheep and lambs in Egypt (SHEDEED et al., 2019).

The stool score of the calf group given propolis was found to be 3, which is the most suitable and optimum score (TOLON et al., 2002). In a study in which propolis was added to the rations of piglets, it was found that diarrhea was 52% lower in the propolis group than in the CG fed the same ration (GUO and DİNG, 2010). In this study, the lowest diarrhea score was seen in group 3 of all three groups given the milk substitute. It was observed that morning diarrhea ceased in the evening and evening diarrhea stopped in the morning in both groups given propolis. Diarrhea was not observed for a long time in the same animal. As a result of the study, it was determined that propolis was effective against diarrhea and that it could be used as a preventive measure.

In terms of economics, the cost of one animal in CG was 0.80 $ per day, and 0.19 $ for the experimental groups. In addition, since the mothers of the kids were milked, additional income was provided for the business. It is known that the milk yield of dairy goats peaks in the first 2 months. It is not economical to use milk in feeding kids during this period. This study proved that it is much more economical to separate the kids from their mothers in the first week after taking colostrum, and to feed them with a mixture containing cow's milk and whey. In many studies on ruminants, propolis was added to the feed in powder form without being extracted, and positive results were obtained (LANA et al., 2007; OZTURK et al., 2010; SARKER and YANG, 2010), but considering the price of raw propolis, it is not economical to use it in this way. In our study, an ethanolic extract of propolis was used. The daily cost per animal was found to be 0.04$.

Conclusions

According to the results of live weight, body measurements, body temperatures, diarrhea scoring and the blood analysis of the kids in the study, it was observed that Saanen kids raised with propolis supplement and the milk substitute (whey+ cow milk and water) showed the same development as the kids fed with mother's milk. It was concluded that it would be economical in all respects to use whey and whey powder, which is seen as waste, especially for goat rearing during and after the suckling period.

Propolis at different levels was effective on the body temperature in kids. The milk substitute and different doses of propolis had a positive effect, especially on the glucose values of the goat kids during the nursing period. It was concluded that kids consuming propolis benefit more from energy sources.

The lower rates of RBC, HGB, HTC, and MCH, which are the red blood cells in the blood of Saanen goats responsible for the transport of oxygen and carbon dioxide, could be explained by the fact that Aydın is 52 m above sea level. The fact that there was no significant difference between the averages of red blood cells between the CG and the milk substitute groups (EG1, EG2, EG3) was important in terms of showing that feeding the kids with the feed with added whey did not cause anemia. In our study, on the 30th day it was observed that the highest increase in GRA% rates was in CG, comprised of kids suckled by their mothers, and EG1, given only milk substitute.

The least diarrhea cases were seen in EG3 and then in EG2. This shows that propolis could be used as natural diarrhea prevention in kids fed the milk substitute, but further studies on the subject are recommended. The ethanolic extract of propolis is recommended as a protective and supportive product, in the form of a feed additive for kids before weaning and during rumen development.

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Author contributions
All the authors contributed to the study conception and design. Material preparation and data collection were performed by all the authors. Data analysis was performed by all the authors. All the authors read and approved the final manuscript.

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MANAV, S., M. YILMAZ: Učinak sirutke i propolisa na pokazatelje rasta, krvnu sliku i proljev u jaradi. Vet. arhiv 93, 223-238, 2023.

SAŽETAK

Ovo je istraživanje provedeno kako bi se pronašla ekonomičnija i zdravija zamjenska hrana za mlijeko u uzgoju koza, i to dodavanjem sirutke u prahu i propolisa kravljem mlijeku. Ukupno 40 jaradi sanske pasmine ojarenih u isto vrijeme podijeljeno je u četiri skupine po deset jedinki, sedam dana nakon jarenja. Kontrolna skupina od 10 jaradi (CG) držana je sa svojim majkama, dok su tri pokusne skupine (EG1, EG2, EG3) bile odvojene od majki. Jarad u svim trima pokusnim skupinama hranjeni su zamjenskim mlijekom (kravlje mlijeko, sirutka u prahu i voda). U skupini EG2 jarad je dobivala 0,4 cc propolisa, a u skupini EG3 0,2 cc propolisa dodanog u zamjensko mlijeko jedanput na dan. Pokazatelji rasta i razvoja te rektalna temperatura mjereni su jedanput tjedno. U svim su skupinama uzeti uzorci proljeva u jutarnjim i večernjim satima te su provedene biokemijske i hematološke pretrage. Dobivenim rezultatima ustanovljene su znakovite razlike u temperaturi tijela te vrijednostima glukoze i ureje među skupinama ($P<0,05$). Analizirane su jedinke unutar svake skupine te se pokazalo da su vrijednosti eritrocita znakovite u svim skupinama. Razlika među pokazateljima rasta i razvoja jaradi u pokusnim skupinama i kontrolnoj skupini, koja nije bila znakovita, važno je otkriće koje upućuje na to da se kozje mlijeko može sačuvati za isplativije namjene. Zapaženo je da je propolis učinkovit u slučaju proljeva te se može preventivno davati. Uočeno je i da je hranjenje jaradi mliječnom zamjenom ekonomičnije od kozjeg – majčina mlijeka. Ovo istraživanje pokazuje da primjena zamjene za mlijeko, uz dodatak sirutke i propolisa, pozitivno utječe na rast, razvoj i zdravlje jaradi.

Ključne riječi: jarad; sirutka; propolis; pokazatelji rasta; vrijednosti krvne slike; proljev