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Full Length Article

Effect of Synbiotics in Creep Feed on Productive Performance and Selected Fecal Characteristics of Goat Kids

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Abstract

The objective of this study was to determine an optimal dose of inulin supplementation as an alternative practice for enhancing performance, immunity, or health status in goat kids. Inulin from Jerusalem artichoke and BACTOSAC-P® were used at w/w ratio 1:9 as the sources of prebiotic and probiotic, respectively. Twenty goat kid crossbreds (Thai native x Anglo-Nubian) were fed with milk on day 1–30, concentrate feed, roughage, and milk until weaned on day 31–75, and concentrate and roughage or each on day 76–90. Five groups of four animals each were assigned into a randomized block design and were fed colostrum for 5 days before the start of the experiment. There were five dietary treatment groups; control diet (T1), feed supplemented with synbiotic at 0.01% (T2), 0.02% (T3), 0.03% (T4), and 0.04% (T5) of diet (DM), respectively. The results showed that final body weight, average daily gains, and feed conversion ratio were significantly different ($P < 0.05$), in all the groups on synbiotic. Moreover, fecal score (day 14) and Lactic acid bacteria during receiving diets (days 14, 56 and 84) and total bacteria were significantly different ($P < 0.05$) among dietary treatments. Percentages of phagocyte activity (%PA) were significantly increased ($P < 0.01$) among dietary treatments, specifically for the supplementation of synbiotic at 0.03% of DM. Furthermore, using synbiotics at four supplement levels significantly decreased phagocyte activity (PA) which was significantly increased ($P < 0.05$) among dietary treatments.

Keywords: Goat kid; Synbiotic; Fecal characteristics; Jerusalem artichoke

Introduction

Synbiotic is a type of a feed additive that contains both a probiotic and prebiotic that work together to improve the microflora of the digestive tract of animals. The use of natural prophylactic supplements for animal has received a great deal of attention in the past decade. Synbiotics are essential part of maintaining overall gastrointestinal health through stimulation of bacterial growth, inhibition of pathogens, and nourishment of probiotics. According to the United Nations Food and Agriculture Organization (FAO), the dietary supplement can be labeled as "synbiotic" only when symbiotic heath benefit can be obtained (Cecic and Chingwaru, 2010)

The utilization of antibiotic is restricted in animal feed. Use of prebiotics, however, is important in gastroenterology, because they can have similar effects as those of antibiotics. The use of prebiotics allows prebiotics to thrive and prevail the pathogens. Use of prebiotic with probiotic known as "symbiotic" is considered safe and effective. The probiotic will thrive then adds only probiotic because they sub serve together and more probiotic passes to the intestine (Wanaporn, 2014). Synbiotics are a combination of probiotics and prebiotics that can improve the survival of probiotic organisms because the processed substrate is available for fermentation. This could result in advantages to the host through increased availability of the live microorganisms. Products with both prebiotic and probiotic have been shown to improve the survival of beneficial microflora. This project was aimed to study the effect of synbiotic for increasing the production performance and immune modulation of goat kids.

Materials and Methods

Animal and Treatments

Twenty goat kid crossbreds (50% x 50% Thai native x Anglo-Nubian), were selected with regards to sex (10 male, 10 female), and fed colostrum for 5 days before the start of the experiment. During the experimental period, goat kids received only milk from days 1–30 (stage 1). Thereafter, for

days 31–75 (stage 2), they were fed concentrate and roughage more specifically, and decreased amounts of milk until weaned. During the final stage (stage 3) of the experiment, days 76–90, they were fed only concentrate and roughage. There were five dietary treatments, all of which were fed the same basal diet (T1) and supplemented with symbiotic at 0.01% of DM (T2), 0.02% of DM (T3), 0.03 % of DM (T4) and 0.04% of DM (T5). Prebiotic inulin from Jerusalem artichoke (*Helianthus tuberosus* L.) with probiotic (BACTOSAC-P®; *Lactobacillus acidophilus*, *Lactobacillus plantarum*, *Pediococcus pentosaceus*, *Streptococcus faecium*, *Sacchalomyces cervisiae*, *Bacillus subtilis* and *Bacillus licheniformis*) were used at ratio 1:9 (w/w) as the sources of prebiotic and probiotic, respectively.

Sample Collection and Analysis

Parameters such as initial weight, final weight, increase in weight, feed intake, average daily gain (ADG), and feed conversion ratios (FCR), were collected at all three stages of the experiment. On the morning of days 14, 28, 42, 56, 70, and 84, 05 mL of blood from the cephalic vein was collected and divided into three subsamples as described by Weir (1978). Fecal score and fecal pH were determined through samples collected to rectal retrieved, on the mornings of days 14, 28, 42, 56, 70 and 84. Fecal samples were scored by a similar specialist on all gathering days as indicated by the accompanying framework (Kara *et al*., 2012); 1= watery, diarrhea; 2= soft, unformed; 3= soft, formed; 4= hard, formed and 5= hard, dry pellets. Fecal pH was measured immediately following the collections with an electronic pH meter (PT-10, Sartorius AG, Goettingen, Germany) fitted with a glass electrode. Each fecal sample was placed in a 50 mL measuring utensil and diluted 10-fold with distilled water as described by Verlinden *et al*. (2006). Stool from each goat kid was removed from pen's floor and kept at 4oC for bacterial enumeration (ISO-15214, 1998). The total numbers of *Escherichia coli* (ISO-4831, 1991) was determined by the three tubes most probable number (MPN). Lauryl sulphatetrytose broth (LTB) was used as selective enrichment medium. Brilliant green lactose bile broth (BGLB) and EC-medium were used as confirmation mediums. The number of tubes that showed gas formation in the BGLB and EC-confirmation-broth was counted. The approximate numbers of *Escherichia coli* were calculated according to the MPN tables (de Man, J.C. MPN tables. ISO4831.1991). Nutrient compositions of pelleted starter concentrate and pangola hay on a dry matter basis (AOAC, 1995) showed in Table 1. Randomized detection of microorganisms in creep feed after mixing before using (Table 2). During the suckling period, kids were closely monitored to ensure sufficient sucking.

Statistical Analysis

Data were statistically analyzed according to a randomized complete block design (RCBD). Significant differences between treatments were determined using Duncan's News Multiple Range Test (DMRT) by SAS (1996).

Table 1: Nutrient compositions of starter concentrate and pangola hay on a dry matter basis

Item (%)	Concentrate[2] (n=12)*	Pangola hay (n=12)*
Dry matter	90.95	95.21
crude protein	20.81	7.35
Organic matter	92.98	91.54
NDF	23.14	73.46
ADF	11.51	42.15
Ether extract	4.35	1.92
Acid insoluble ash	8.63	8.45

Note: * = Random sampling for analysis 100 g per week, [1]Nutrient analyses of the feeds were performed according to the Association of Official Analytical Chemists (AOAC, 1995). [2]Contained the main ingredients; ground corn grain, fish meal, peanut meal, rape seed meal, coconut meal, wheat bran, rice bran, leucaena, cassava ship, corn gluten meal, sunflower meal, barley, molasses, vegetable oil, mineral and vitamin mix, limestone, salt. NDE=Neutral detergent fiber, ADF= Acid detergent fiber

Results

Final body weight, average daily gain (ADG) and feed conversion ratios (FCR) were recorded as; 17.50, 19.80, 20.39, 20.40 and 20.51 kg; 175.0, 211.5, 217.8, 222.3 and 222.3 g/day and 2.79, 2.32, 2.24, 2.19 and 2.19, in T1, T2, T3, T4 and T5, respectively as shown in Table 3. Results showed that all treatment groups with supplementation of synbiotics significantly improved ($P < 0.05$) when compared to control diet (T1).

The results showed that fecal score at day 14 records show; 2.25 (T1), 3.00 (T2), 2.75 (T3), 3.25 (T4) and 3.00 (T5). Treatment groups T1 and T3 had a significantly lower fecal score ($P < 0.05$) when compared to treatment groups T2, T4 and T5 as shown in Table 3. Lactic acid bacteria were recorded on day 14 (4.23, 5.50, 6.43, 6.93 and 6.45 $\log_{10}$/g), day 56 (4.90, 5.60, 5.90, 5.93 and 6.28 $\log_{10}$/g) and day 84 (5.23, 5.63, 5.73, 5.78 and 6.05 $\log_{10}$/g), and total bacteria (8.37, 8.63, 8.73, 8.78 and 8.78 $\log_{10}$/g) was significantly increased ($P < 0.05$), meanwhile there was no increase in *Escherichia coli* among dietary treatments. Synbiotic supplementation increases nutrients available to helpful microorganisms in the body. This increases the number and activity of these life forms in the gut and enhances the survival rate of probiotics amid their position of the digestive tract section through the stomach related tract. The results in Table 4 show that plasma cholesterol and hematological traits (WBC, RBC, hemoglobin, hematocrit, lymphocyte, neutrophils, monocyte, eosinophil, basophil and platelet count) were not different ($P > 0.05$) among dietary treatments.

The results of this experiment showed the percentages of phagocyte activity (%PA), the index of phagocyte activity (IPA), and the number of engulfed *Escherichia coli* (strain ATCC 25922). It was found that %PA at 14, 28, 42, 56, 70 and 84 days was significantly increased ($P < 0.01$), among dietary treatments, and that IPA at 42, 56, 70 and 84 day was significantly increased ($P < 0.05$) among dietary treatments.

Table 2: The analysis microbial in diet of goat kids[1]

Items	Synbiotic levels in rations (%)					Analytical methods
	T1	T2	T3	T4	T5	
Bacillus spp. (cfu/g)	$1.3x10^5$	$2.6x10^5$	$4.1x10^5$	$5.3x10^5$	$7.5x10^5$	In house method: WI 18A-1 based on health protection agency national standard method F15 : (ISO/IEC 17025:2005)
Mesophilic LAB (cfu/g)	$<10^1$	$<10^1$	$5.6x10^3$	$6.7x10^5$	$1.4x10^6$	ISO 15214 : 1998
Yeats (cfu/g)	$<10^2$	$<10^2$	$6.3x10^2$	$2.4x10^4$	$1.1x10^5$	ISO 21527-2 :2008
Enterococcus spp. (cfu/g)	$<10^1$	$<10^1$	$3.9x10^4$	$6.2x10^5$	$1.2x10^6$	In house method: WI 18A-8 based on compendium of methods for the microbiological examination of foods : 4th ed., 2001, chapter 9
Presumptiv *E. coli* (MPN/day)	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	ISO 7251 : 2005
Salmonella spp.*	-	-	-	-	-	ISO 6579 : 2002

Note: [1] Sampling for analysis 25g per packed in plastic bag 1 kg, *not detected in 25 g of sample, control diet (T1), synbiotic supplemented 0.01% of DM (T2), 0.02% of DM (T3), 0.03% (T4) and 0.04% of DM (T5), MPN = most probable number of coliform organisms (*Escherichia coli*) obtain three most probable number table/100 ml and cfu = colony forming unit

Table 3: The effects of synbiotic supplementation on productive performance, fecal score and fecal bacterial populations of goat kids

Items	Synbiotic levels in rations (%)					SEM	P-value		
	T1 (*n=20*)	T2 (*n=20*)	T3 (*n=20*)	T4 (*n=20*)	T5 (*n=20*)		sex	trt	sex*trt
Initial weight (kg)	4.38	3.93	4.05	3.73	3.79	0.10	ns	ns	ns
Final weight (kg)	17.50^a	19.80^b	20.39^b	20.40^b	20.51^b	0.29	ns	*	ns
Increase weight (kg)	13.13^a	15.88^b	16.34^b	16.68^b	16.53^b	0.33	ns	*	ns
Feed intake (g)	428.88	428.46	426.38	425.86	425.39	0.50	ns	ns	ns
ADG (g/day)	175.0^a	211.5^b	217.8^b	222.3^b	222.3^b	0.004	ns	*	ns
FCR	2.79^a	2.32^b	2.24^b	2.19^b	2.19^b	0.04	ns	*	ns
Fecal score[1]									
14 day	2.25a	3.00^b	2.75^{ab}	3.25^b	3.00^b	0.09	ns	*	ns
28 day	2.75	3.50	3.50	4.00	4.25	0.19	ns	ns	ns
56 day	4.00	4.00	4.25	4.25	5.00	0.12	ns	ns	ns
84 day	4.75	4.75	5.00	5.00	5.00	0.07	ns	ns	ns
Fecal pH	7.04	6.96	7.00	7.04	7.01	0.02	ns	ns	ns
Fecal bacteria population[2]									
Escherichia coli (MPN)									
0 day	4.40	4.30	4.38	4.00	3.43	0.47	ns	ns	ns
14 day	5.38	4.85	4.4	4.63	4.63	0.1	ns	ns	ns
28 day	5.90	5.00	5.65	4.40	5.28	0.23	ns	ns	ns
56 day	6.15	5.38	5.10	5.15	5.10	0.19	ns	ns	ns
84 day	5.73	4.8	4.95	4.53	5.05	0.13	ns	ns	ns
Lactic acid bacteria (log_{10}/g)									
0 day	5.8	5.03	6.28	4.23	4.0	0.3	ns	ns	ns
14 day	4.23^a	5.50^{ab}	6.43^b	6.93^b	6.45^b	0.25	ns	*	ns
28 day	4.63	5.88	5.75	6.00	6.15	0.17	ns	ns	ns
56 day	4.90^a	5.60^{ab}	5.90^b	5.93^b	6.28^b	0.11	ns	*	ns
84 day	5.23^a	5.63^{ab}	5.73^{ab}	5.78^b	6.05^b	0.07	ns	*	ns
Total bacteria (log_{10}/g)	8.37^a	8.63^{ab}	8.73^b	8.78^b	8.78^b	0.04	ns	*	ns

Note: [a,b] Means in row with different superscripts letter are significant differences ($P < 0.05$), ns = non-significant ($P > 0.05$), * = significant, control diet (T1), synbiotic supplemented 0.01% of DM (T2), 0.02% of DM (T3), 0.03% (T4) and 0.04% of DM (T5), ADG = average daily gain, FCR = Feed conversion ratios, [1]Fecal scoring system; 1=watery, diarrhoea; 2=soft, unformed; 3=soft, formed; 4=hard, formed; and 5=hard, dry pellets. [2]Bacterial populations in sterile feces sampled from a subset (n =10) of healthy kids in each group on day 14, 28, 42, 56, 70 and 84, MPN = most probable number of coliform organisms (*Escherichia coli*) obtain three most probable number table/100 mL, log_{10} = a logarithm to the base 10 and SEM = Standard error of mean

The results of this trial demonstrated that the rates of phagocyte movement (%PA) action of the goat kids supplemented of synbiotic (Table 5). These results showed that goat kid supplemented with synbiotic with 0.03% of DM had the best %PA, which corresponds to the higher IPA for all groups supplemented with synbiotics. Because, a measure of phagocytic movement controlled by tallying the quantity of microorganisms ingested per phagocyte amid a constrained period hatching of a suspension of microscopic organisms and phagocytes in serum. These rates of the trial were likewise more noteworthy than the rates at the test. In the present review, the %PA increment as the Lactic acid bacteria number increment it is conceivable that there is certain relationship between the quantity of Lactic acid bacteria and %PA.

Discussion

Increased body weight is possibly a result of increasing flow of microbial nitrogen in large intestine from stable microflora composition at rumen, small and large intestine of calves (Verdonk *et al*., 1998). However, the increase of ADG and the decrease of FCR can also indicate the improved ability of diets to better increase body weight. Synbiotics give more added substance benefits in development execution; sustain transformation proportion, hematological and biochemical parameters than probiotic and prebiotic singular utilization of these added substances (Abdel-Fattah and Fararh, 2009).

To control the measure of microscopic organisms as a punishment, adhering to demoralize rivalry or catch surface and enhances intestinal microbial equalization inside.

Table 4: The effects of synbiotic supplementation on plasma cholesterol, hematological traits of goat kids

Items	Synbiotic levels in rations (%)					SEM	P-value		
	T1 (*n=20*)	T2 (*n=20*)	T3 (*n=20*)	T4 (*n=20*)	T5 (*n=20*)		sex	trt	sex*trt
plasma cholesterol (mg/dL)	145.15	149.43	149.61	149.86	151.25	1.11	ns	ns	ns
WBC, % 10^4/µL	1.98	1.98	2.03	2.02	2.00	0.09	ns	ns	ns
Lymphocytes,%/µL	49.47	54.68	53.39	55.5	56.82	1.07	ns	ns	ns
Neutrophils,%/µL	44.25	43.18	44.22	42.97	42.75	0.43	ns	ns	ns
Monocytes,%/µL	2.86	2.50	2.54	2.54	1.93	0.19	ns	ns	ns
Eosinophils,%/µL	4.36	4.00	3.68	3.86	3.11	0.24	ns	ns	ns
RBC, 10^6/µL	8.14	8.20	8.24	8.29	8.28	0.15	ns	ns	ns
Hemoglobin,g/dL	8.16	8.41	8.27	8.42	8.35	0.18	ns	ns	ns
Hematocrit,%/µL	22.15	23.37	22.6	22.77	22.84	0.29	ns	ns	ns

Note: ns = non-significant ($P > 0.05$), control diet (T1), synbiotic supplemented 0.01% of DM (T2), 0.02% of DM (T3), 0.03% (T4) and 0.04% of DM (T5), WBC = white blood cell, RBC = red blood cell and SEM = Standard error of mean

Table 5: Effects of synbiotic supplementation on percentages of phagocyte activity (%PA) and index of phagocyte activity (IPA) of goat kids

Items	Synbiotic levels in rations (%)					SEM	P-value		
	T1 (*n=20*)	T2 (*n=20*)	T3 (*n=20*)	T4 (*n=20*)	T5 (*n=20*)		sex	trt	sex*trt
Percentages of phagocyte activity (%PA)									
0 day	29.07	28.71	28.65	28.58	29.26	0.14	ns	ns	ns
14 day	29.68^{a}	30.71^{c}	30.39^{bc}	30.76^{c}	30.03^{ab}	0.07	ns	**	ns
28 day	29.52^{a}	32.37^{c}	31.57^{bc}	32.03^{c}	30.73^{b}	0.15	ns	**	ns
42 day	30.26^{a}	32.94^{c}	32.28^{bc}	32.90^{c}	31.69^{b}	0.10	ns	**	ns
56 day	29.25^{a}	33.61^{c}	32.73^{bc}	33.64^{c}	32.15^{b}	0.13	ns	**	ns
70 day	29.23^{a}	32.90^{cd}	32.18^{bc}	33.50^{d}	31.61^{c}	0.14	ns	**	ns
84 day	29.30^{a}	32.44^{c}	31.01^{b}	32.75^{c}	30.56^{ab}	0.20	ns	**	ns
Index of phagocyte activity (IPA)									
0 day	4.20	4.24	4.25	4.34	4.31	0.02	ns	ns	ns
14 day	4.39^{ab}	4.75^{c}	4.22^{a}	4.60^{bc}	4.64^{bc}	0.04	ns	*	ns
28 day	4.33	4.59	4.43	4.46	4.47	0.05	ns	ns	ns
42 day	4.25^{a}	4.61^{b}	4.48^{b}	4.54^{b}	4.48^{b}	0.03	ns	*	ns
56 day	4.05^{a}	4.62^{b}	4.30^{ab}	4.70^{b}	4.47^{b}	0.06	ns	*	ns
70 day	3.93^{a}	4.43^{b}	4.43^{b}	4.63^{b}	4.41^{b}	0.06	ns	*	ns
84 day	3.65^{a}	4.27^{b}	4.10^{ab}	4.39^{b}	4.10^{ab}	0.06	ns	*	ns

Note: ^{a,b} Means in row with different superscripts letter are significant differences ($P < 0.05$), ns= non-significant ($P > 0.05$), *= significant, **= highly significant, control diet (T1), synbiotic supplemented 0.01% of DM (T2), 0.02% of DM (T3), 0.03% (T4) and 0.04% of DM (T5) and SEM = Standard error of mean

However, the gastrointestinal tract is a vital protective system and the biggest safeguard shielding the hosts from poisons and pathogens while permitting development of commensal microorganisms (Medzhitov and Janeway, 2000). The prebiotics in the synbiotic blend enhance the survival of the probiotics in the gastrointestinal tract and improves the action of the host's intestinal microbes (Boirivant and Strober, 2007; Vandenplas *et al*., 2013; (Hozan, 2016). While, there was less effect on fecal *Escherichia coli* counts and growth performance in calves fed with synbiotic (Toshiya *et al*., 2011), the decreases in microorganisms was to be faulted such as *Clostridium* and *Escherichia coli* makes measure of smelling salts in the intestinal tract and in the blood diminished have the impact of hindering cancer-causing agents. Fat amalgamation in the liver subsequently, lipid and cholesterol in the blood diminished (Schijver, 2001; Kaur and Gupta, 2002), Swanson and Junior (2002) said key part of Bifidobacteria and Lactobacilli have chemicals disintegrate proteins bunch azoreductase, nitroductase, nitrate reductase and β-glucuronides low protein causes these poisons. Additionally, synbiotic supplementation keeps population of non-beneficial or potentially pathogenic microbes such as *Escherchia coli* at moderately low levels in the cecum digesta and small intestine (Abdel-Raheem *et al*., 2012). Hosts receive various benefits from their gastrointestinal microflora, including drug digestion; supplement creation, protection against pathogens, detoxification and immune improvement. Creature contemplates have shown changes in these gut microorganisms can bring about safe dysregulation; enhance development and impact on execution, and there are data that supports the utilization of probiotics and prebiotics and particularly synbiotic. The synbiotic ideas about component of activity: changing the organization of intestinal microflora by feasible advantage life form and non-absorbable living being substrates (Hozan, 2016).

Animals received symbiotic medication show triglyceride, cholesterol, high-density protein cholesterol, low-density protein cholesterol, albumin, globulin, total serum protein, glucose and hematocrit in hematological assessment (Hozan, 2016). Likewise, symbiotic feed can significantly decrease the level of total cholesterol and increase high-density lipoprotein cholesterol in lambs (Farinu *et al*., 2004). Nonetheless, hemoglobin level in blood of all calves was comparative toward the start of analysis, though hemoglobin level in 56 day in calves that received inulin in sum 3 g/day/head was higher than that in calves from other groups. Hematocrit level both at starting and

toward the end of analysis in calves from all gatherings was comparable (Krol, 2011).

The phagocytosis of microorganisms is one of the nonspecific protection methods of essential significance for the host. The monocyte/macrophage cell lines, usually called processional phagocytes, can kill, overwhelm, and pulverize particles, including irresistible operators, and possess a high phagocytic potential (Aderem and Underhill, 1999). In this regard, these cells have been as frequently assessed for phagocytic and lytic limit against pathogenic microorganisms. Because, innate immune replication constitutes the first line of defense against invading pathogens, phagocytosis is a component of innate immune response and is, consequently, essential for organism health. Phagocytes activity involves kinetic processes in response to chemotactic stimulus, adhesion, eradication and removal of digested particles. Failure in the phagocytic activity leads to immune deficiencies that can include chronic and recurring infections (Lehmann *et al*., 2000; Dinauer, 2005). The results of Verlinden *et al*. (2006) show phagocytic activity (PA) of polymorph nuclear and mononuclear blood leukocytes from sheep and goats was quantified utilizing two variants of inert particles ingestion. This data can be used to determine the optimal amount and period of prebiotics and probiotics supplementation productive performance, immune modulation, and health status in adolescent ruminants.

Conclusion

The impact of synbiotic in creep feed is beneficial to hematological attributes of goat kids, resulting in improved production performance and fecal score. Specifically, synbiotics supplemented at 0.03% of DM, has been shown to enhance feed conversion ratio, average daily gains and final body weights. These improvements are likely to influence microbial populations and phagocyte activity as well. Be that it may, possible mechanisms of action of beneficial probiotics stimulating the production of antimicrobial substances, competing for adhesion on epithelium and enhancing of the immune system of goat kids.

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