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Influence of Medicinal Plants Mixture on Productive Performance Cross Bred Dairy Goats

[1]F. Mirzaei, [2]S. Prasad and [3]S. Savar Sofla
[1]Division of Livestock Production and Management, Animal Sciences Research of Iran(ASRI), Iran
[2]Division of Livestock Production and Management, National Dairy Research Institute, Karnal, Haryana, India
[3]Division of Genetics and Breeding, ASRI, Iran

Corresponding Author: F. Mirzaei, Division of Livestock Production and Management, Animal Sciences Research of Iran(ASRI), Iran Tel: +919896915669

ABSTRACT

This study was carried out to evaluate the effect of dried mixture of five herbal plants as natural additives on milk yield and composition of cross bred dairy goats. Thirty lactating goats after two weeks of kidding were divided into 3 groups (ten animals each) using complete random block design to evaluate the effect of herbal mixture supplement on the productivity of lactating goats. Treatment 2 (T_2) and treatment 3 (T_3) were supplemented with polyherbal combination at the rate of 125 and 250 mg kg^{-1} body weight, respectively. Goats without polyherbal combination served as Control group (T_1). Animals were fed on 40% concentrate feed mixture and green fodder ad libitum. Dry Matter Intake (DMI) was slightly increased for animals fed on T_2 ration compared to T_1 and T_3. Apparent nutrients digestibility and Total Digestible Nutrients (TDN) were significantly improved by treatments. Milk yield, 4% Fat Corrected Milk (FCM), milk protein, fat, total solids, feed efficiency (DMI/Milk yield and DMI/4% FCM) and economic efficiency were significantly higher for animals fed T_2 followed by T_3 and then T_1 (control). Glucose contents and Total Leukocyte Count (TLC) were higher in animals which received experimental additives than those received control. Results clearly indicated that combination of herbal supplementation in different treatments recorded the lowest rate of Dry Matter Digestibility (DMD) compared to control group. It may be concluded that adding the combination of polyherbal supplementation to rations improved the productivity of lactating goats with no deleterious effects on general health.

Key words: Medicinal plant, dairy goat, milk yield, milk composition, feed intake

INTRODUCTION

Beneficial effects of herbs or botanicals in farm animals may arise from the activation of feed intake and the secretion of digestive secretions, immune stimulation, anti-bacterial, Herbs can also contribute to the nutrient requirements of the animals, stimulate the endocrine system and intermediate nutrient metabolism (Wenk, 2003). One of the most successful attempts accomplished in the last decade is using feed additives such as natural additives (medicinal plants as its seeds, leaves and roots).These supplements assist in improving animal productivity and milk production enhancement (Campanile *et al*., 2008; Wang *et al*., 2009), however, most studies have been conducted with lactating cows. In the last decade, natural additives such as *Asparagus racemosus*, *Trigonella foenum graecum* seeds, *Carum carvi*, *Nigella sativa* and chamomile flower have been increased the central concern of scientists as useful resource for treating diseases and improving animal productivity (Abo El-Nor, 2000; Kholif and Abd-El-Gawad, 2001; Dalvi *et al.*, 1990). Medicinal plant seeds improved the productivity of lactating animals and its hormonal alert effect through increasing prolactin and growth hormone release, in addition to activating udder tissues in line with increasing glucose concentration (Abo El-Nor *et al.*, 2007; Drackley *et al.*, 2001).

Therefore, the present study was undertaken to see the effect of natural additives in combination on milk yield and composition of lactating goats.

MATERIALS AND METHODS

This study was conducted at the Experimental Farm in goat section of National Dairy Research Institute, Karnal, India during January to April 2009.

Preparation of herbal supplements: Individual herb was procured from local market after assessing their quality in consultation with ayurvedic practitioners and drug manufacturers. Each herb was pulverized separately. The Polyherbal biostimulator feed additives was prepared after mixing powderized herbs in specific proportion. The polyherbal supplementation contained; *Asparagous racemosous* (Shatavari), *Leptadenia reticulata* (Jivanti), *Nigella sative* (Kolonji), *Cuminum cyminum* (Jeera) and *Pueraria tuberosa* (Vidarikand).

Lactation trial: Two level of polyherbal combination with concentrate mixture and ad libitum green fodder were chosen to be used in the lactation trial.

Feeding and management: Thirty lactating Alpine x Beetal cross bred goats after two weeks of kidding aged 2-3 years and weighting on average of 42±3.25 kg at the 2nd-3rd season of lactation were randomly assigned into three groups (ten each) using complete random block design. The experimental period was extended to 12 weeks. The animals were introduced to the following treatments; (1) control group without polyherbal supplement as T_1, (2) treatment 1 with 125 mg kg^{-1} body weight polyherbal supplement as T_2, (3) treatment 2 with 250 mg kg^{-1} body weight polyherbal supplement as T_3.

Experimental additives were mixed with 1 kg of concentrate mixture introduced to animals daily morning meal. Diet was formulated to meet the animal's requirements (NRC, 1981). Animals were fed grouply with concentrate mixture and green fodder (berseem) were offered twice daily at 9:00 a.m. and 2:00 p.m., respectively. Dry Matter Intake (DMI) was recorded every two weeks by weighing feeds offered and refused by the animals. Fresh water was available to the animals all time. Chemical composition of ingredients is shown in Table 1.

Apparent digestibility: Digestibility trial was applied during the last week of experiment using six animals from each group. Offered, residuals and fecal samples were collected after 24 h and were taken 100 g of each samples for further achievements, then were dried at 55°C for 48 h and then ground to pass a 1 mm sieve in a feed mill (FZ102, Shanghai Hong Ji instrument Co., Ltd., Shanghai, China) for chemical analysis. The digestibility coefficient of certain nutrient was calculated according to the following formula (Ferret *et al.*, 1999).

Feed and fecal analysis: Feedstuffs and fecal samples were analyzed according to the AOAC (1995) methods to determine Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF) and

Table 1: Chemical composition of concentrate, polyherbal supplement and green fodder (% on DM basis)

Item	Concentrate	Polyherbal supplement	Berseem-mustard mix	Lucerne	Berseem
DM	89.57	91.26	10.59	18.36	15.44
Ash	8.09	5.20	21.31	12.73	13.47
OM	91.91	94.80	78.69	87.27	87.53
CP	20.85	15.75	19.42	22.09	18.86
EE	2.83	13.80	2.81	3.80	3.90
CF	9.65	21.21	13.64	19.82	21.11
NFE	58.57	44.04	39.87	41.56	42.66

ash contents. Organic Matter (OM), Nitrogen Free Extract (NFE) contents and Total Digestible Nutrients (TDN) were calculated by related formula.

Sampling and analysis of milk: Individually, milk samples were collected daily along the experimental period (12 weeks). The animals were handily milked (twice/day) and milk yield was recorded. Milk samples were analyzed for total solids, solids not fat, fat, protein by infrared spectrophotometry (Funke Gerber Milko-Scan, Germany) according to AOAC (1997) procedures. Fat corrected milk (4% fat) was calculated by using the following equation according to Gaines (1928): 4% FCM = 0.4 x milk yield (kg)+15×fat yield (kg).

Blood parameters: Blood samples were collected from the jugular vein of each animal at the last day of each fortnight (1 h before the 07:00 h feeding). The collected blood samples were centrifuged at 4000 r.p.m./20 min. to separate the plasma. The obtained plasma was stored at -18°C till analysis. Total Leukocyte Count (TLC) was determined by the Haemocytometer as described by Schalm (1961) and glucose by end-point o-Toluidine method (Dubowski, 1962) was estimated.

Statistical analysis: Data were analyzed using the SYSTAT 12 ©, SYSTAT Software, Inc. to account for effects of treatment, period, interactions between treatment and period and animal within treatment. The treatment was considered a fixed effect; period and animal within treatment were considered random effects. The Duncan's multiple range test was used to test the significance between means (Duncan, 1955).

RESULTS AND DISCUSSION

Apparent digestibility: It is well established that, all combinations additives slightly increased ($p>0.05$) the values of apparent nutrient digestibility coefficients than that in control (Table 2). Animals fed T_2 and T_3 showed higher ($p>0.05$) digestion coefficient values for dry matter and crude protein than those fed T_1 (control). Also, all additives showed higher ($p>0.05$) digestion coefficient values for organic matter, crude fiber and nitrogen free extract than control. However, all additives showed higher ($p>0.05$) digestion coefficient value of ether extract than control. Moreover, Alam *et al.* (2005) also did not find significant difference in DM, OM and N digestibility when *Albizia* were offered to growing goats untreated or treated with calcium hydroxide. Bayssa (2006), found digestibility coefficient of EE significantly higher ($p<0.05$) in treatment groups than control.

Experimental additives in T_2 slightly improved nutritive values as total digestible nutrients and digestible crude protein of rations compared with T_3 and T_1 (Table 2). Results obtained with polyherbal biostimulants in low level might indicate the stimulation of rumen micro-flora activity

Table 2: Apparent nutrient digestibility and nutritive value of the experimental rations

	T_1 (Control)	T_2	T_3	SEM	p-value
Apparent nutrients digestibility (%) DM					
DN	65.32	69.00	71.20	2.25	NS
OM	69.80	74.52	74.52	1.89	NS
EE	51.14	61.04	59.64	6.37	NS
CF	50.94	52.42	54.23	3.42	NS
CP	72.48	75.57	75.73	1.62	NS
NFE	75.22	76.72	79.59	1.52	NS
Nutritive value (g/h/day)					
DCP	366.49^b	366.63^b	344.78^a	2.32	0.001
TDN	1251.48^b	1251.95^b	1177.35^a	7.93	0.001

Each value represents an average of 7 samples. TDN: Total digestible nutrients, T_1: Control ration with any supplementation, T_2: Ration with 125 mg//head/day. polyherbal supplement, T_3: Ration with 250 mg/head/day. polyherbal supplement, Means in the same line with different letters are significantly different

through saving some micro factors to rumen micro-flora such as micro elements, vitamins, hormones and enzymes which are required to the efficient digestion, absorption and metabolism (Aboul-Foutouh *et al*., 2000) and/or minimizing effectively hazards of mycotoxins by inhibition of fungi growth and aflatoxins production Allam *et al.* (1999), Mohamed *et al.* (2003), Aboul-Foutouh *et al.* (2000), Ali *et al.* (2005) and El-Ashry *et al.* (2006) observed similar results when they added polyherbal supplements or other medicinal plants to dairy buffaloes or growing lambs.

Blood parameters: Data in Table 3 showed that animals fed supplemented rations had higher ($p<0.01$) TLC concentrations than control. These results may be due to the improvements occurred in metabolic process as a response to the experimental additives. The concentrations of glucose were in the normal range for healthy animals and were higher in supplemented groups than control. These results are parallel with values Ali *et al.* (2005) found that chamomile supplemented goats ration increased blood glucose values ($p<0.05$). Stella *et al.* (2007) found no significant effect of yeast culture supplementation on plasma glucose of lactating goats. These results indicated that tested additives to lactating goat's rations did not negatively affected liver activity or animal's health.

Dry matter intake: Data of Table 4 showed that total Dry Matter Intake (DMI) was not significantly affected by experimental additives. Values of DMI calculated as proportion from Metabolic Body Size (MBS) (kg kg^{-1} $W^{0.75}$/day) showed a slightly increase ($p>0.05$) with experimental additives compared to control. Kholif and Khorshed (2006), Campanile *et al.* (2008) and Wang *et al.* (2009) suggested that DMI were not affected by additives to animal rations while, Abo El-Nor and Kholif (2005) reported that DMI was not affected by additives to dairy goat's rations.

Milk yield and composition: The productive performance data and milk analysis are shown in Table 4. Milk and 4% FCM yields in the present study were slightly higher ($p>0.05$) in low level supplemented group compared to high level supplemented and control groups and were in agreement with Kholif and Khorshed (2006), Abo El-Nor *et al.* (2007) and Campanile *et al.* (2008). The addition of polyherbal combination increased the net energy of milk for dairy goat, according to higher organic matter digestibility, thus leading to an increase in milk yield. The relative

Table 3: Effect of different additives on some blood parameters of lactating goats

	T_1 (Control)	T_2	T_3	SEM	p-value
Glucose (mg dL^{-1})					
1st month	72.40	82.70	76.60	4.69	NS
2nd month	69.20	69.70	72.30	1.64	NS
3rd month	55.70	54.40	60.10	3.58	NS
Overall	65.77	68.93	69.67	2.04	NS
Total Leukocyte Count (cells mL^{-1})					
1st month	11350.00	9570.00	12065.00	1057.80	NS
2nd month	10515.00[a]	11835.00[a]	14470.00[b]	1004.04	0.03
3rd month	10205.00	10360.00	12715.00	970.34	NS
Overall	10690.00[a]	10588.33[a]	13083.33[b]	583.91	0.004

Means in the same line with different letters are significantly different

Table 4: Effect of different additives on milk yield, FCM, milk composition % and feed and economic efficiencies in lactating goats

Item	T_1 (Control)	T_2	T_3	SEM	p-value
Live body weight (kg)	42.85	42.30	43.50	2.06	NS
DMI (kg/h/d)	56.65	52.22	51.69	9.32	NS
MBS ($W^{0.75}$/kg)	142.01	134.56	131.88	22.86	NS
Milk yield (kg/h/d)	2.20[b]	2.27[b]	2.00[a]	0.07	0.01
Fat corrected milk (kg/h/d)	1.98	2.14	1.84	0.12	NS
Milk composition					
Protein (%)	2.97	2.99	3.00	0.01	NS
Fat (%)	3.32	3.38	3.40	0.06	NS
Lactose (%)	4.51	4.47	4.47	0.02	NS
Solids not fat (%)	8.24	8.23	8.30	0.04	NS
Total solids (%)	11.56	11.54	11.68	0.08	NS
Feed and economic efficiencies					
DMI/Milk yield (kg)	1.05	0.98	1.32	0.17	NS
DMI/4% FCM (kg)	1.19	1.05	1.47	0.19	NS
Overall cost of diet/h/d ($)	0.32	0.34	0.35	0.02	NS
Return milk sale/h/d ($)	0.67	0.70	0.67	0.04	NS
Net return over feed cost/h/d ($)	0.36	0.37	0.29	0.04	NS

Means in the same line with different letters are significantly different

improvement of milk production of T_2 might be due to the healthy effect of polyherbal additives and the associated effect between acetate and succinate on rumen microflora which lead to improvement of feed efficiency and milk production (Abo El-Nor and Kholif, 2005). In this study, levels of serum energy indicators (glucose) of treated goats was higher (Table 3) suggesting that higher dry matter utilization of treated goats provided enough energy to support the increased milk production Stella *et al.* (2007).

Data of milk composition showed that milk protein, fat, TS and SNF contents were higher ($p>0.05$) in animals fed experimental additives than control. Kholif and Khorshed (2006) found that rations supplemented with yeast significantly increased milk protein and lactose contents compared with control. In the other studies, milk fat, protein and lactose contents were not affected by polyherbal supplementation (Erasmus *et al.*, 2005; Campanile *et al.*, 2008) fed lactating goats on polyherbal supplemented rations and found that treatments slightly increased milk TS and SNF contents.

Generally, feed efficiency calculated as milk yield/DMI and 4% FCM/DMI were significantly improved by T_2 followed by T_3 and T_1. Also, economic efficiency of these additives takes the same trend of feed efficiency (Table 4, 5). The highest relative efficiency was recorded with T_2 whereas T_1 and T_3 showed the lower, respectively.

Data presented in Table 5 show the effect of different lactation periods (week) on milk yield, milk composition and feed efficiency. Milk yield and 4% FCM were increased (p>0.05) gradually with periods advancement up to 8th week of lactation period and decreased gradually then after. Also, feed efficiency (milk yield/DMI) and (FCM/DMI) were taking the same trend of milk yield. Milk constituents were significantly affected by different lactation periods in different groups. These

Table 5: Effect of different lactation periods on milk yield, milk composition and feed efficiency in treatment groups

	Periods (week)							
Item	2	4	6	8	10	12	SEM	p-value
T_1								
DMI (kg/h/d)	1.38^{a}	1.43^{b}	1.93^{c}	1.94^{c}	2.08^{e}	1.99^{d}	0.02	0.001
MY (kg/h/d)	2.46	2.41	2.35	2.45	2.05	2.32	0.22	NS
4%FCM (kg/h/d)	1.99	2.08	2.15	2.11	1.97	1.87	0.17	NS
Milk composition								
Protein (%)	3.00^{c}	2.90^{a}	2.91^{a}	2.88^{a}	2.88^{a}	2.96^{b}	0.03	0.05
Fat (%)	2.98	2.97	3.11	2.70	3.17	2.83	0.15	NS
TS (%)	10.92	11.05	11.04	11.10	10.70	11.36	0.17	NS
SNF (%)	8.34^{c}	8.07^{ab}	8.08^{ab}	8.00^{a}	8.00^{a}	8.20^{bc}	0.08	0.04
Feed efficiency (kg)								
Milk yield/DMI	1.78^{c}	1.69^{c}	1.24^{b}	1.26^{b}	0.99^{a}	1.16^{b}	0.09	0.001
4% FCM/DMI	1.42^{c}	1.46^{c}	1.12^{b}	1.09^{b}	0.95^{a}	0.94^{a}	0.11	0.05
T_2								
DMI (kg/h/d)	1.39^{a}	1.42^{a}	1.94^{b}	1.92^{b}	2.17^{c}	1.91^{b}	0.03	0.001
MY (kg/h/d)	2.23	2.19	2.43	2.42	2.22	2.58	0.20	NS
4% FCM (kg/h/d)	1.91	1.72	2.41	2.22	2.02	2.08	0.17	NS
Milk composition								
Protein (%)	$2.99d^{e}$	2.98^{d}	2.80^{a}	2.84^{b}	2.89^{c}	3.02^{e}	0.02	0.001
Fat (%)	3.19^{c}	3.20^{c}	3.13^{c}	2.72^{b}	3.52^{d}	2.49^{a}	0.12	0.001
TS (%)	10.66^{a}	10.97^{ab}	10.94^{ab}	11.01^{b}	10.76^{ab}	11.84^{c}	0.26	0.04
SNF (%)	8.33	7.78	7.74	7.88	8.04	8.32	0.21	NS
Feed efficiency (kg)								
Milk yield/DMI	1.60c	1.54c	1.25b	1.26b	1.03a	1.35b	0.11	0.03
4%FCM/DMI	1.37	1.21	1.24	1.16	0.93	1.09	0.11	NS
T_3								
DMI (kg/h/d)	1.31^{a}	1.44^{b}	1.77^{cd}	1.78^{d}	2.08^{e}	1.72^{c}	0.03	0.001
MY (kg/h/d)	1.95	1.81	2.14	2.15	1.94	2.46	0.26	NS
4%FCM (kg/h/d)	1.59	1.50	2.04	2.14	1.68	2.12	0.23	NS
Milk composition								
Protein (%)	3.04^{d}	2.95^{bc}	2.84^{a}	2.91^{b}	2.99^{c}	3.06^{d}	0.03	0.001
Fat (%)	3.14^{c}	2.78^{b}	3.15^{c}	3.11^{c}	3.31^{c}	2.46^{a}	0.17	0.007
TS (%)	11.60^{cd}	11.33^{bc}	10.64^{a}	11.24^{b}	11.40^{bc}	11.76^{d}	0.18	0.001
SNF (%)	8.43^{d}	8.19^{bc}	7.86^{a}	8.08^{b}	8.30^{c}	8.45^{d}	0.07	0.001
Feed efficiency (kg)								
Milk yield/DMI	1.5	1.26	1.21	1.21	0.93	1.43	0.22	NS
4% FCM/DMI	1.26	1.05	1.14	1.20	0.81	1.23	0.21	NS

Means in the same line with different letters are significantly different results clearly indicated that different week recorded in T_{2t} were the highest milk production and feed efficiency compared to T_3 and T_1. Kumar (2009) and Beyan (2009) found similar trend of milk yield in different phase of lactation of lactating cows and goats, respectively.

The significant negative relationship between TS and milk fat in supplemented and control groups of the present study is somewhat similar to the observations of Belewu (1995) and Ahamefule *et al.* (2007) who reported small but positive relationship between these two components. The result appears plausible since SNF and MF which are negatively correlated in T_1 and positively in T_2 and T_3 in the present study, are the two major components of TS. TS was positively significantly ($p<0.05$) correlated with P in T_2 and T_3 but negatively in T_1. It was significant relationship between TS and SNF contents of milk, respectively, imply that the observed increase in the TS of milk was due to the corresponding increase in SNF and P contents of the milk which is also a confirmation that milk constituents are components of TS and anything that affects the milk constituents will invariably affects the TS in the milk (Table 6).

The findings corroborate previous reports. Similarly, the significant positive correlation between TS and SNF in T_3 and the significant positive relationships between TS and CP in T_2 and T_3 in

Table 6: Relationships between various components of milk (kg) of the experimental goats under different treatments

Parameter						
X	Y	Reg. equation	R	R^2	SE	p-value
T_1						
TS	Fat	0.013 +0.235X	0.979***	0.959	0.003	0.001
TS	SNF	-0.013+0.765X	0.998***	0.996	0.003	0.001
TS	P	-0.004+0.273X	0.998***	0.995	0.001	0.001
Fat	SNF	-0.042+3.087X	0.965**	0.931	0.012	0.002
Fat	P	-0.014+1.104X	0.965**	0.931	0.004	0.002
P	SNF	-0.002+2.795X	0.999***	0.999	0.002	0.001
MY	Fat	0.016+ 0.025X	0.946**	0.895	0.005	0.004
MY	P	-0.001+0.030X	0.975***	0.961	0.004	0.001
T_2						
TS	Fat	0.004+0.283X	0.937**	0.878	0.007	0.004
TS	SNF	-0.001+0.710X	0.989***	0.979	0.007	0.001
TS	P	0+0.255X	0.989***	0.978	0.003	0.001
Fat	SNF	0.026+2.084X	0.876*	0.768	0.023	0.022
Fat	P	0.010+0.747X	0.876*	0.767	0.008	0.022
P	SNF	-0.001+2.767X	1.00***	1.00	0.001	0.001
MY	Fat	0.005+0.033X	0.915*	0.837	0.008	0.011
MY	P	-0.001+0.031X	0.995	0.990	0.002	0.001
T_3						
TS	Fat	-0.008+0.321X	0.984***	0.968	0.004	0.001
TS	SNF	0.008+0.679X	0.996***	0.993	0.004	0.001
TS	P	0.023+0.176X	0.893**	0.797	0.007	0.017
Fat	SNF	0.033+2.020X	0.965**	0.932	0.014	0.002
Fat	P	0.028+0.547X	0.901*	0.812	0.007	0.014
P	SNF	-0.027+3.033X	0.879*	0.773	0.025	0.021
MY	Fat	-0.011+0.040X	0.976***	0.953	0.005	0.001
MY	P	0.021+0.022X	0.891*	0.794	0.007	0.017

Means in the same line with different letters are significantly different. TS: Total solids, P: Protein, SNF: Solids-not-fat, MY: Milk yield, r: Correlation coefficient, R2: Coefficient of determination, SE: Standard error contrast with T1 confirm previous findings by Belewu (1995), Ahamefule *et al.* (2007) and Tona (1999), respectively. The highly significant ($p<0.01$) and negative correlation between MF and SNF in T_1 (control) depicts an inverse relationship between these two major components of milk. This is of nutritional interest as emphasis is laid on consumption of animal products with less fat content.

Hence, the minimum standards for market milks are fixed for fat and SNF contents to ensure quality milk supply to the consumers and to prevent adulteration of milk. Svennersten-Sjaunja *et al.* (1997) analysed various milking records of cows on different farms in Sweden and found that the consumer's demand was milk with moderate or low fat content. It thus appears that one of the ways of reducing MF content is to attempt to manipulate the diets of the animals such that it favours more production of SNF at the expense of the fat which has been shown in Table 5 for supplemented groups. The result agrees with the findings of Belewu (1995) who observed a small but negative relationship between MF and SNF but disagrees with the report of Tona (1999) who indicated significantly positive relationship between these two milk components which is in agreement with present results for supplemented groups. The variation in the result could be ascribed to the fact that fat is the most variable component of milk.

The insignificant negative correlation between MF and CP contradicted the positive but non-significant and significant relationships reported by Belewu (1995) and Tona (1999), respectively. Variation in results may be due to differences in the milk composition of temperate breeds of goat and tropical breeds. The significant and negative correlation between MF and MY showed that as the MY increases, MF decreases. This appears plausible since feeding of supplementary concentrate diets is usually accompanied by alteration of the volatile fatty acids with production of more propionate which is glucogenic and supplies the energy for milk synthesis at the expense of acetate and butyric which are lipogenic and used for milk fat synthesis. This connotes that nutritional intervention or manipulation that aimed at increasing of MY is beneficial as it will be accompanied by butterfat reduction.

Parallel observations were made by Beauchemin and Rhode (1997) and Ahamefule *et al.* (2007) who reported inverse relationship between MY and butterfat. The significantly and positively correlated relationship between MF and gross energy agrees with the reports of Belewu (1995) and Adeneye(1993) who stated that milk caloric value is controlled largely by MF content since fat is a rich energy source. There was a small but positive relationship between MY and P which implies that any feeding regime which improves MY will equally improve the milk P content; this appears beneficial considering the nutritional roles of protein.

CONCLUSIONS

It could be concluded that lactating goat's rations supplemented with combination of polyherbal supplements showed the best improvement of nutrients digestibility, milk production, milk composition and economic efficiency compared to animals fed the control diet. Also, no deleterious effects on general health of the treated animals were observed. However, polyherbal supplementation of diet improved their milk production and that both positive and negative relationships existed between milk constituents of cross bred dairy goat which implies that it is possible to use the regression equations to predict one constituent from the other. Further studies are needed to determine the exact ratio of these combinations and respective mechanisms that elicit these positive effects on milk production on high yielding goats.

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