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Nutritional Science

EFFECT OF SUPPLEMENTATION OF FEEDING FALLEN AND SORTED APPLE ONTHE PERFORMANCE OF LACTATING COWS

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ABSTRACT The present study was conducted to evaluate the effect of supplementation of feeding fallen and sorted apple on the performance of lactating cows. Eighteen multiparous dairy cows (2-4 lactation number) were divided into three groups based on the average milk yield. The animals in the group-1(6 cows, average milk yield of 7.34kg per day,control, C) where fed maize fodder, concentrate mixture as per the requirement, while the animals in the group-2(6 cows, average milk yield of 7.35 kg per day, Apple fed group, T1) were fed maize fodder, concentrate mixture as per the requirement and chopped fresh fallen apple 4 kg per animal per day, while the animals in the group-3 (6 cows, average milk yield of 7.37kg per day, Urea treated apple group, E2) where fed maize fodder, concentrate mixture as per the requirement and 4% urea treated fallen apple 500g per animal per day. The milk yield in lactating cows of C, T1 and T2 were comparable and did not vary significantly. There were no significant differences in the haematological parameters of C, T1 and T2 groups. Dry matter intake (DMI) was similar among the threegroups. Average fortnightly body weightswere not statistically significant among the threeexperimental groups. It was observed that apparent digestibility coefficients (%) of dry matter, organic matter, ether extract, neutral detergent fibre and acid detergent fibre were comparable among the three groups. The milk yield, dry matter intake, fortnightly body weight changes, digestibility of the nutrients were also not statistically significant among the threegroups. Hence, it is concluded that thesupplementation of fallen apple and urea treated appleon the lactating cows did not affect significantly the intake and digestibilty of nutrients as well as milk production and its composition.

KEYWORDS : Fallen apple, Urea treated apple, Milk yield, Milk composition

Introduction

The chronic shortage of feeds and fodders in India leads to the poor productivity of Indian livestock,which mustproperly be addressed immediately for maintaining and improving production efficiency of the livestock (Patil et al.,2009). In India, there is currently a net deficiency of 35.6% green fodder, 10.95% dry fodder and 44% concentrate feed materials in the country (IGFRI, 2015). A huge quantity of about 1.3 billion tonnesof fruits was wasting per year and the palatable apple waste which were rich source of sugar, pectin, phenolic components, minerals and vitamins (Wadhwa et al.,2015). Apple production is the highest (10.62 lakh MT) in the Jammu and Kashmir, second highest (6.25 lakh MT)in Himachal Pradesh, third highest (0.62 lakh MT) in Uttarkhand (Chhimwalet al., 2019). Being the major horticultural produce the fruit apple becomes the back bone of the rural economy of Jammu and Kashmir, Himachal Pradesh and UttarkhandStates (Yildizhanet al., 2021).

Utilization of fruit wastes in the efficient way as a animal feed supplement would reduce the cost of feeding and it will be useful practice in waste management in terms of reducing environmental pollution (Pandey et al., 2020). Therefore, it is better to utilize this newer feed as a supplement in order to reduce the gap between the requirement and supply of feeds (Habib et al.,2016). Considering all the above facts, the present experiment was conducted to study the effect of feeding fallen and sorted apples and urea treated apples on feed intake, nutrient digestibility,milk yield and its composition in lactating Vrindavanicows.

Materials and methods

Location of the study

The study was conducted in the dairy farm of the ICAR-Indian Veterinary Research Institute, Mukteshwar, India located at 29.472°N and 79.647°E. The experiment was conducted in September, 2020 to February, 2021 with daily minimum temperature of 11.6° (52.9°F) to maximum temperature of 20.5°C (68.9°F). The average rainfall recorded about 1301mm.

Animals and treatments

A total of 18 lactating cows based on the lactation number and milk yield were selected and distributed into three groups of6 animals each i.e.,C (Control), T1 (fresh chopped apple) and T2 (urea treated chopped apple) in order to avoid biasedness. The lactating cows of group Cwere fed to fulfill the nutrient requirements as per ICAR (2013) recommendations. The fresh fallen apple were collected, chopped and removed their seeds before fed to lactating cows (T1) at the quantity of 4 kg on fresh basis per animal daily along with the concentrate feed. The energy from the fallen apple were adjusted accordingly by reducing the amount of concentrate mixture. The fresh fallen apple were collected, chopped, removed their seeds and treated with 4% urea. The urea treated chopped apple were fed about 500 grams on fresh basis per animal along with the concentrate mixture to the lactating cows of the treatment group T2. The protein from the urea treated apple were adjusted accordingly by reducing the amount of protein from the concentrate mixture.

Blood Sampling

The blood sample were collected on 0th day, 60th day and 120th day of the feeding trial and analysed for their haematological, serum biochemical, serum enzyme and erythrocytic antioxidant parameters in the three different experimental groups.

Analytical techniques

The fresh sample of fallen apple were collected, stored in a dry cool place.The fresh sample of fallen apple and 4% urea treated apple were analysed for their crude protein content. The fresh sample were dried in hot air oven and analysed for their dry matter. The dried samples were ground and used for proximate analyses. Milk yield wasrecorded every day and milk composition analysed. Fortnightly body weight was also recorded. The digestibility trial was conducted and samples were collected to assess the nutrient utilisation parameter, haematological, serum biochemical, enzyme parameters and erythrocytic antioxidant indices.

Statistical analysis

The effect of supplementation of feeding fallen apple strategy were analysed by the one-way ANOVA using the SPSS software Version 21. The probabilities with the difference (P) greater than 0.05 were considered as statistically non-significant. Data were presented as Mean ± SE.

Results

Chemical composition of feeds and fodders

The chemical composition (% DM Basis) of fresh fallen apple and urea treated apple was given in the Table-2. The dry matter, organic matter, total ash, crude protein, ether extract, NDF and ADF in fresh fallen apple were 15.04±0.41, 92.95±.0.09, 7.05±0.81, 6.10±0.27, 2.31±0.45, 56.49±0.63 and46.32±0.14 respectively. The dry matter, organic matter, total ash crude protein, ether extract, NDF and ADF in urea treated apple were 31.97±0.29, 92.41±0.38,7.59±0.84, 23.32±0.62, 4.06±0.31, 61.78±0.79 and 59.43±0.12 respectively.

Table 1 Physical Composition of concentrate mixture % for Lactating cow

Feed Ingredient	Lactating cows
Wheat bran	42
Deoiled soyabean meal	20
Maize	35
Mineral mixture	2
Salt	1

Table 2 Chemical composition (%) of experimental feed

Nutrient composition (%)	Maize fodder	Concentrate mixture	Wheat straw
DM	21.53±0.41	88.91±0.16	90.89±0.37
CP	10.11±0.33	19.45±0.62	4.15±0.92
OM	90.50± 0.32	93.91±0.52	89.97±0.01
EE	2.11±0.13	3.19±0.33	1.09±0.28
NFE	42.83±0.33	67.96±0.38	45.05±0.49
CF	8.10±0.63	4.74±0.51	29.78±0.16
NDF	47.17±0.57	25.98±0.64	75.89±0.73
ADF	32.14±0.29	40.49±0.45	42.78±0.58
Total Ash	9.50±0.41	6.09±0.73	10.03±0.03

Table 3 Chemical composition (%) of fresh fallen apple and 4% Urea treated apple

Chemical composition (%)	Fresh fallen apple	4%Urea treated Apple
Dry matter	15.04±0.41	18.97±0.29
Organic matter	92.95±.0.38	92.41±0.20
Crude protein	6.23±0.27	21.82±0.62
Ether extract	2.31±0.45	4.06±0.31
Crude Fibre	12.37±0.53	20.41±0.33
Nitrogen free extract (NFE)	67.45±0.74	69.73±0.49
Neutral detergent fibre (NDF)	56.49±0.26	61.78±0.97
Acid detergent fibre (ADF)	46.32±0.14	59.43±0.11
Total ash (TA)	7.05±0.84	7.59±0.58

Fortnightly Body weight of the lactating cows

The average body weight of the lactating cows in C,T1 and T2 were 554.72±9.11, 550.98±6.14 and 546.79±8.47 respectively. The fortnightly body weight of the lactating cows were presented in the Table-4. There was no significant statistical difference between the groups.

Table 4 Fortnightly body weight (kg) in lactating cows

FORTNIGHT	E1	E2	E3
0	530.83±6.21	527.22±7.61	530.79±5.60
1	535.87±9.77	530.18±4.34	537.78±8.81
2	544.67±9.97	538.51±5.48	542.54±.8.73
3	553.50±9.16	548.34±3.65	557.29±8.36
4	562.25±8.73	556.12±4.34	569.04±6.64
5	571.50±8.82	567.78±7.92	574.49±5.13
6	584.40±8.76	588.65±4.16	515.56±8.12
Average	554.72±9.11	550.98±6.14	546.79±8.47

Dry matter Intake and Nutrient utilisation

The dry matter intake of the control (C), treatment 1 (T1) and treatment 2 (T2) were presented in the Table-5. Nutrient digestibility of C,T1 and T2 were presented in the Table-3. There was no significant statistical difference exists between the groups in the dry matter intake and nutrient digestibility.

Table-5 Fortnightly Dry matter intake (DMI) (kg/day) in lactating cows

FORTNIGHT	C	T1	T2
0	14.09±0.32	13.11±0.73	13.17±0.93
1	14.11±0.46	12.51±0.82	14.57±0.57
2	14.31±0.68	11.59±0.91	14.62±0.66
3	14.52±0.73	14.65±0.95	11.69±0.47
4	14.56±0.54	13.69±0.84	12.77±0.66
5	13.67±0.65	12.73±0.43	14.83±0.43
6	13.51±0.97	14.51±0.55	13.57±0.28
Average	12.69±0.56	13.26±0.22	13.60±0.57

Table-6 Nutrient digestibility (%) in lactating cows

Nutrient	C1	T1	T2	P value
DM	62.36±0.62	63.41±0.75	61.91±0.87	0.600
OM	67.59±0.28	68.22±0.42	62.33±0.8	0.596
EE	67.28±0.76	66.67±0.46	61.05±0.5	0.548
CP	61.27±0.85	63.17±0.54	69.84±0.27	0.596
NDF	52.58±1.10	50.67±0.17	55.81 ±0.43	0.903
ADF	31.71±0.89	33.16±0.41	32.19±0.30	0.469

Table 7 Nutrient intake and digestibility (%) in lactating cow

Attributes	C	T1	T2	P value
Dry matter				
Intake	12.69±0.56	13.26±0.22	13.60±0.57	0.243
Digestibility (%)	62.36±0.62	63.41±0.75	61.91±0.87	0.933
Organic matter				
Intake	12.01±0.47	12.78±0.69	12.33±0.38	0.282
Digestibility(%)	67.59±0.28	68.22±0.49	62.33±0.88	0.918
Crude protein				
Intake	567.76±0.35	559.12±0.54	532.72±0.64	0.286
Digestibility(%)	61.27±0.8	63.17±0.5	69.84±0.2	0.853
Ether extract				
Intake	379.66±0.39	409.17±0.96	399.94±0.21	0.393
Digestibility(%)	67.28±0.7	66.67±0.4	61.05±0.5	0.655
Neutral detergent fibre				
Intake	312.88±0.67	345.89±0.75	355.77±0.33	0.463
Digestibility (%)	52.58±1.1	50.67±0.1	55.81 ±0.4	0.580
Acid detergent fibre				
Intake	294.56±0.67	288.44±0.45	256.33±0.62	0.208
Digestibility (%)	31.71±0.89	33.16±0.41	32.19±0.30	0.529

NUTRIENT INTAKE AND DIGESTIBILITY

Table 8 Plan of nutrition of Lactating cows during the metabolic trial

PARTICULARS	COMPARISION	E1	E2	E3
Body weight (BW)	(kg)	530.83±6.21	527.22±7.61	530.79±5.60
DMI	ICAR (2013) requirement(kg/d)	13.54±8.92	13.67±5.84	13.83±7.12
	Actual Intake (Kg/d)	12.69±0.56	13.26±0.22	13.60±0.57
	% of ICAR (2013)	93.73%	97.00%	98.34%
CPI	ICAR (2013) requirement(g/d)	578.99±0.55	585.33±0.23	580.61±0.22
	Actual Intake (g/d)	567.76±0.35	559.12±0.54	532.72±0.64
	% of ICAR (2013)	98.06%	95.53%	91.76%
TDNI	ICAR (2013) requirement(kg/d)	5.49±0.22	5.74±0.27	5.66±0.32
	Actual Intake (Kg/d)	5.22±0.29	5.61±0.30	5.41±0.23
	% of ICAR (2013)	95.08%	97.74%	95.59%

Milk yield and Milk composition

The average fortnightly milk yield of the group C, T1 and T2 were7.26±0.57, 7.24±0.86 and 7.28±0.77respectively. The fortnightly average milk yield (kg/day) of the lactating cows were presented in the Table-5. The average milk composition (%) such as fat, SNF, protein and lactose were presented in the Table-10.There were not significant statistical significance between the groups.

Table-9 Fortnightly average milk yield (kg/day) of lactating cows

FORTNIGHTS	C	T1	T2	P value
0	7.34±0.51	6.27±0.27	6.36±0.49	0.812
1	7.28±0.21	7.29±0.37	7.42±0.39	0.267
2	7.27±0.81	7.95±0.29	7.51±0.71	0.156
3	7.34±0.73	7.62±0.24	7.84±0.93	0.345
4	7.45±0.88	7.36±0.97	7.37±0.57	0.211
5	7.25±0.43	6.91±0.38	7.25±0.68	0.507
6	6.95±0.23	7.31±0.24	7.22±0.49	0.318
AVERAGE	7.26±0.57	7.24±0.86	7.28±0.77	0.055

Table-10 Average milk composition (%) of lactating cow

Group	FAT	SOLID NOT FAT	PROTEIN	LACTOSE
Control (C)	3.62±0.17	8.83±0.71	2.97±0.67	4.65±0.82
Treatment group-1 (T1)	3.65±0.39	8.47±0.56	3.07±0.20	4.72±0.81
Treatment group-2 (T2)	3.62±0.14	8.33±0.28	2.67±0.41	4.56±0.37
P value	0.986	0.762	0.451	0.333

Haematological parameters

The haematological parameters of the group C, T1 and T2 such as haemoglobin, packed cell volume, WBC, neutrophil, lymphocytes, monocytes were presented in the Table-11.The serum biochemical parameters such as glucose, BUN, total protein, albumin, globulin, A:G ratio of the C, T1 and T2 were presented in the Table-12. The data of the C, T1 and T2 in the haematological parameters, serum biochemical parameters were in the normal range and there was no significant statistical difference exist between the groups.

Table-11Haematological parameters

Haematological parameters	C	T1	T2	P value
Hb(g/dl)	9.32±0.44	9.39±0.52	9.39±0.37	0.390
PCV(%)	31.34±0.49	32.09±0.31	31.77±0.14	0.211
WBC (x 103/µl)	10.69±0.43	10.59±0.74	10.53±0.39	0.793
Neutrophils (%)	24.01±0.83	23.29±0.51	25.99±0.68	0.333
Lymphocyte(%)	71.93±0.78	72.74±0.31	73.55±0.54	0.382
Monocytes (%)	2.60±0.60	2.99±0.37	2.79±0.29	0.903
Basophil (%)	0.87±0.14	0.95±0.17	0.81±0.13	0.584
Eosinophil(%)	3.21±0.33	3.13±0.18	3.02±0.12	0.405

Table-12 Serum biochemical parameters

Serum biochemical parameters	E1	E2	E3	P value
Glucose (mg/dl)	52.37±0.29	55.80±0.18	57.07±0.93	0.640
BUN (mg/dl)	22.45±0.93	22.34±0.20	25.85±0.43	0.294
Total protein (g/dl)	7.62±0.30	7.70±0.21	7.96±0.46	0.242
Albumin (g/dl)	4.13±0.84	4.16±0.19	4.24±0.52	0.391
Globulin (g/dl)	3.49±0.19	3.54±0.22	3.72±0.03	0.963
A:G ratio (g/dl)	0.84±0.40	0.85±0.33	0.87±0.23	0.995

DISCUSSION

Chemical composition

The protein concentration of DAP and EAP compared well with the value of 65 g/kg DM (Carson et al.,1994). Crude protein and ash content were low, while contents of OM, CF, EE and NFE were high in apple pomace (Ghoreishiet al.,2007).

Dry matter Intake

Because of the good palatability of the apple pomace causes increased dry matter intake. It was found that DMI was significantly reduced in the cows fed 15% apple pomace silage but increased with cows fed 30% apple pomace silage (Ghoreishiet al.,2007).

Milk yield and milk composition

Supplementation of ensiled mixed tomato and apple pomace (EMTAP) who found that the milk yield increased because of the increased DM intake, nutrient digestibility and palatability of the diet, compared to the control (Abdollahzadeh, et al., 2010). Milk yield increased when apple pomace silage mixed well with wheat bran, chopped alfalfa and milled rice bran about 10% on DM basis and fed to dairy cows (Toyokawa et al., 1984).

Daily milk yield and 3.5% FCM were positively affected (P<0.05) by inclusion of EMTAP in the diet of cows. Clear remarkable increases (P<0.05) were noticed in the yield of milk fat 38.87g and protein 33.35g for R3 (feeding 40% of EMTAP) compared with control (R1) (no EMTAP), in which yields of the milk fat and protein were 27.05g and 27.98g respectively (Abdollahzadeh, et al., 2010).

In the goats fed ration contained 50% EMTAP (R3) had significant increases (P<0.05) in percentages of all the milk constituents when compared to the other experimental groups(Abdollahzadeh, et al., 2010).

The apple pomace silage can successfully substitute a ration containing alfalfa 46%, barley 38.5% and 12% cotton seed meal with the ration containing alfalfa 16%, barley 33.5%, 20% cotton seed meal and APS 30% without any negative effect on milk yield and milk composition (fat, protein and SNF).Milk total solids and SNF contents were significantly increased in the overall tested rations (R2, R3 and R4) compared with the control R1, and the differences among them were not statistically significant (Ghoreishi et al., 2007)

Digestibility/ Nutrient utilisation

The higher digestibility of DM and OM in the diet containing apple pomace due to presence of more NFE, appreciable quantities of soluble carbohydrates which was equivalent to corn silage (Rumsey et al.,1978). In this present study there was no significant differences in the digestibility of DM and OM in the three different experimental groups.Abdollahzadehet al., 2010 reported that ensiled mixed tomato pomace having high protein and apple pomace having low protein combination made improvement in nutrient utilisation ability. The sufficient nitrogen with optimizing the degradable: undegradable protein ratio could be maximize the digestibility of ruminant rations (Miller et al.,2002).

Blood parameters

The percentage of the blood urea increased significantly in the cows fed with apple pomace instead of corn silage (Oltjenet al., 1977). Feeding different levels of apple pomace causes the albumin in the normal range of about 3.25 to 4.27 g/dl and the globulin concentration highest in the higher levels of feeding apple pomace (40%) and the activity of the serum enzymes decreased significantly with increased levels of apple pomace feeding (El Nahaset al., 2010).

Economics

The fallen apples are available at the price of Rs.5/kg in the hilly areas. It can be supplemented in the dairy cows so that the concentrate mixture can be reduced accordingly. The results were similar with the control group. Hence the fruit waste can be utilised efficiently by reducing the use of conventional feed sources.

The apple pomace can be used to replace the maize by about 33% in the dairy ration so that it can be a cost-effective dairy cattle ration. There were no significant effect on the milk yield and composition among the experimental groups (Tiwari et al.,2008).

Conclusion

The effect ofsupplementation of the fresh fallen apple and 4% urea treated apple in the lactating cows indicated that the milk yield and milk composition were similar with the control group. The utilisation of the fruit waste were found to be a alternative feed source for rearing livestock in hilly areas and it reduces the environmental pollution due to dumping of fruit waste.

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