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EFFECT OF VARYING NDF LEVELS ON PRODUCTIVE PERFORMANCE IN LACTATING NILI RAVI BUFFALOES

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ABSTRACT

The aim of study was to evaluate the effect of varying levels of dietary NDF on voluntary feed intake, nutrient digestibility, milk production and composition in early lactating (n=25) Nili Ravi buffaloes. Five groups with five animals in each, under completely randomized design were fed A, B, C, D and E rations which were iso nitrogenous and isocaloric based on NDF levels 23, 28, 33, 38 and 43%, respectively. Nutrient intake and nutrient digestibility differ ($P<0.001$) significantly among the dietary groups. Dry matter (DM), crude protein (CP) and neutral detergent fibre (NDF) intake (kg/d) were found highest in animals fed diet C (14.31±0.05), C (1.86±0.006) and E (5.52±0.018) respectively than those on the other four treatments. Whereas, DM, CP and NDF digestibility percentage were observed the highest in the group B (62.88±1.04), B (51.00±0.57) and C (64.4±0.99) respectively, as compared to others. The 4% fat corrected milk (kg/day) production was significantly ($P<0.001$) higher in group A (11.23±0.15) as compared to others. In term of milk composition (TS 16.65±0.07%, fat 7.01±0.04%, milk protein 3.78±0.02% and milk lactose 5.04±0.02%) were observed the highest in group D (38% NDF). Hence it is concluded that 33% NDF level is better in terms of NDF digestibility and 23%NDF in terms of 4%FCM production in early lactating Nili Ravi buffaloes.

Key words: Nili Ravi buffaloes, NDF, ADF, voluntary intake, weight gain

INTRODUCTION

In Pakistan, majority of livestock holders cultivate forages, fodders and save crop residues due to cheaper source of livestock feed than concentrates. According to a study only 8 percent of our livestock feed comes from concentrates and the remaining 92 percent comes from forage, fodders and crops residues i.e. fibrous diets (Hanjra *et al.*, 1995). So it is vital to study and explore different aspects of the fibrous diets of livestock and their optimal utilization in major milk and meat producing breeds of animals.

In providing the feed to lactating ruminants, an economical advantage is to use maximum quantity of roughages. Buffalo is remarkably a versatile animal and considered to be a better converter of low quality roughages (high NDF) to more valuable products such as meat and milk (Sarwar *et al*. 1998). Crude fiber (CF) in the ruminant's diets helps in chewing, regurgitation, salivation, maintaining rumen health and pH. Neutral detergent fiber indicates most of the structural components in plant cells. On an average NDF is less digestible than that of non-fiber carbohydrates. Therefore, the concentration of NDF in feed or diet is used to define the upper and lower boundaries of dry matter intake. In high NDF concentration based diets, rumen fill limits dry matter intake. Waldo (1986) recommended that the dietary NDF concentration is best forecaster of DM intake in dairy cows.

Proper NDF ratio in the diet of dairy animals is important to get optimum milk yield from them. In a study Dado and Allen (1995) observed that cows produced 5.2 kg/day more milk and consumed 5.1 kg/day more DM when fed low fiber diets with 25 % NDF as compared with high fiber diet (35 % NDF) of dietary DM on iso-nitrogeneous rations. Increased dietary NDF concentration in dairy animals would likely to increase fat percentage in milk which can partly pay for lower milk production associated with increased net energy intake. Previous research in Pakistan provides very limited information concerning the optimum fiber needs of buffaloes in general and lactating Nili Ravi buffaloes in particular. Keeping in view these facts, the present study was designed to evaluate optimum fiber level for early lactating Nili-Ravi buffaloes.

MATERIALS AND METHODS

An experiment was conducted at Buffalo Research Institute, Pattoki district Kasur Punjab province, Pakistan. Multi-parous early lactating Nili Ravi buffaloes (n=25) were selected and were randomly divided into five groups, under completely randomized design. Each group comprised of animals having approximately alike milk production and lactation stage. The experiment continued for 105 days in which first fifteen days were given to experimental animals for adaptation to their respective diets while, remaining period (90 days) was for the collection of data. Rations were offered daily at 9:00a.m to all respective groups. Water was made available round the clock and animals were facilitated with bath daily. Refusal feed was weighed and wasted before offering fresh weighed total mixed rations. All the animals were milked twice a day at 2:00 a.m and 2:00 p.m. Representative samples of feed, orts and milk were taken weekly and collected for individual animals of each group.

Five iso- caloric and iso- nitrogenous total mixed rations (TMR) were formulated having different levels of NDF (table-1). Ration C contained 33% NDF level as per NRC (2001) and served as control. Ration A and B contained lower (23% and 28%) NDF levels while rations D and E were comprised of higher (38% and 43%) NDF levels. Data on milk production and intake of feed (feed offered- feed refused) were recorded daily. While composition of milk was analyzed on weekly basis. Solid not fat, fat, protein, lactose and total solids percentages were recorded with milk analyzer (EKOMILK, Milkana KAM 98-2A). Data for live weight changes were recorded by weighing the animal in the morning before feeding for each animal at monthly intervals.

The digestibility trial was carried out up to five days before the termination of experiment by using total collection method (Marghazani *et al*., 1999). Three buffaloes out of each group were selected randomly and total feces of each animal were collected and weighed daily. Similarly, feed and fecal samples (20%) were pooled separately for each buffalo after the digestibility trial. All collected samples were analyzed by proximate analysis technique (AOAC, 2000) and for NDF and ADF (Van Soest 1991).

Table 1:Chemical composition of experimental rations

Rations	DM%	CP%	EE%	Ash%	NFE%	NDF%	ADF%
A (23%NDF)	91.46	13.34	3.41	12.4	45.32	23.44	21.10
B (28%NDF)	89.51	13.56	3.39	12.66	41.20	28.21	23.39
C (33%NDF)	91.49	13.48	3.45	12.1	41.66	33.45	25.23
D (38%NDF)	91.87	13.41	3.32	12.4	39.75	38.46	28.46
E (43%NDF)	92.24	13.39	3.27	12.3	39.01	43.62	31.36

Data thus obtained on nutrients intake and digestibility, milk yield and milk composition, were analyzed using ANOVA technique (Steel *et al*., 1997). Statistical analysis was performed using SAS (2000). Means were compared for significance of difference with the Duncan's Multiple Range Test (Duncan, 1955). Mathematical model is given as under:

$$Y_{ij} = \mu + \tau_i + \varepsilon_{ij}$$

Where,

Y_{ij} = Each observation on J[th] animal due to i[th] treatment.

μ = overall mean

τ_i = effect of ith animal due to treatment ($\sum\tau i = 0$ and i = 1--5)

ε_{ij} = random error associated with i th treatment and jth animal with the restriction that variance σ 2 and mean zero.

Table 2: Mean (±S.E) nutrients intake, nutrient digestibility, milk production and composition in Nili Ravi lactating buffaloes fed on different dietary NDF levels

Groups	A	B	C	D	E	Sig. level (P value)
Nutrient Intake						
DM (Kg/day)	12.97^{bc}±0.04	13.0^{b}±0.04	14.31^{a}±0.05	12.90^{bc}±0.04	12.85^{c}±0.04	<0.001
CP (Kg/day)	1.68b^{c} ±0.05	1.69^{b}±0.04	1.86^{a}±0.006	1.67^{bc}±0.005	1.67 ±0.005	<0.001
NDF (Kg/day)	2.98^{e} ±0.009	3.64^{d}±0.01	4.72^{c} ±0.01	4.90^{b}±0.01	5.52^{a}±0.018	<0.001
Nutrient Digestibility						
DM %	61.46^{a}±2.21	62.88^{a}±1.04	62.73^{a}±0.40	55.57^{b}±1.47	51.6^{b}±0.24	<0.001
CP %	48.33^{ab}±3.75	51.00^{a}±0.57	46.00^{ab}±2.3	43.00^{b}±1.15	35.00^{c}±1.73	<0.01
NDF %	62.3^{ab}±0.7	62.6^{ab}±1.13	64.4^{a}±0.99	58.9^{bc}±0.8	56.03^{c}±1.69	<0.01
Milk yield						
Milk yield (Kg/day)	8.06^{a} ±0.11	7.92^{a}±0.06	7.91^{a}±0.06	5.94^{b}±0.06	5.77^{b} ±0.10	<0.001
4% FCM (Kg)	11.23^{a}±0.15	11.12^{a}±0.09	11.09^{a}±0.11	8.61^{b}±0.10	6.06^{c} ±0.15	<0.001
			Milk composition (%)			
Fat %	6.52^{c}±0.03	6.53^{c}±0.04	6.80^{b} ±0.05	7.01^{a} ±0.04	6.56^{c}±0.03	<0.001
SNF	9.22^{c} ±0.04	9.13^{c}±0.04	9.44^{b} ±0.03	9.63^{a} ±0.05	9.72^{a} ±0.02	<0.001
Total solids	15.74^{c}±0.06	15.66^{c}±0.07	16.24^{b}±0.06	16.65^{a}±0.07	16.28^{b}±0.04	<0.001
Protein	3.52^{c}±0.02	3.54^{c} ±0.02	3.61^{b} ±0.01	3.78^{a} ±0.02	3.6^{b}±0.01	<0.001

Means with different superscripts within same row are significantly different (P<0.05);

Nutrients intake and digestion: A significant difference in DM and NDF intake and digestibility was observed as shown in table-2. Among the five diets, DM and CP intake (kg/day) was found the highest (14.31±0.05) and (1.86±0.006), respectively in the group fed diet C with 33% NDF and was reduced to (12.85±0.04) and (1.67±0.005) kg/d, respectively with diet E. These results are in line with the findings of Arelovich *et al.* (2008), they reported that total DM intake decreased in the dairy cattle as the concentration of NDF increased over the range of 22.5 to 45.8 %. Van Soest (1991) and Mertens (1987) in their respective studies concluded that intake of feed can be limited by the bulkiness (fill effect) of the feed in relation to the voluntary intake. Ruminant's rumen and reticulum volume determined the potential of physical intake of forages (Forbes, 1995). Forage fiber is bulky because there is a limited amount of NDF which will fill the rumen of a buffalo. At that limit, buffalo will stop eating.

The NDF intake (kg/day) was observed higher (5.52±0.018) in the groups fed on diet E having of 43% NDF levels than in the lower NDF based diets (A, B, C and D). Results showed a significant difference in DM, NDF and CP digestibility. Among the five treatments DM digestibility % was highest (62.88) in the group diet B with 28.0% NDF level and CP % (51±0.57) in the group fed on the diet B which was found the highest than the other groups. While NDF digestibility % was observed the highest (64.4±0.99) in the group fed diet C (33% NDF) than other diets. These results indicated that as the level of NDF increased the digestibility of DM and NDF was also decreased. Fiber content and its digestibility have the greatest impact on overall digestibility because fiber is the slowest digesting component in feeds. The result showed that high NDF levels as in the case of D and E diets reduced total tract digestibility of dry matter. These results are in line with the findings of Tjardes *et al*. (2002), as they reported that high fibre treatment reduced total tract digestibility of DM.

Milk production: In case of production performance, milk yield was non-significantly different among the diet groups A (8.06), B (7.92) and C (7.91) (kg/day) respectively *i.e* up to 33% NDF based TMR. Whereas, milk production in the diet groups D (5.94) and E (5.77) kg/d was significantly less. A similar trend was observed with regard to 4% FCM, the milk production in the groups A, B and C was 11.23, 11.12 and 11.09 (kg/day) respectively which was observed the highest and non-significant among the diet groups, while in diet groups D and E was (8.61) and (6.06) kg/day, which was the lowest. Comparatively high milk production in diet groups A, B and C is an indication that low fiber diet can enhance the milk production, but milk production is reduced with the increase in NDF level. These results are in line with the findings of Dado and Allen (1995). They reported that cows produced 5.2 kg/day more milk and consumed 5.1 kg/day more DM when fed low fiber diets (25 % NDF) as compared with high fiber diet (35 % NDF of dietary DM) on iso-nitrogeneous rations. The present study results are also in line with the findings of Kendall *et al.* (2009) who reported that cows fed diet containing of 28% NDF produced more milk, fat, and protein than those cows who consumed diets containing 32% NDF.

The milk composition indicates a significantly high fat contents (7.01%) in the group fed on diet D (38% NDF) based diet, whereas fat contents found are lowest in the group fed on diet E (43% NDF) based diet and low NDF based diets as in the groups with low NDF levels as in the groups A, B and C. These low fat contents with 43% NDF based diet might be due to low intake of feed due to rumen fill effect. While low milk fat contents in lower NDF based diet such as in the groups A, B and C may be due to the fact of high propionate to low acetate ratio in the rumen. These results are in line with the findings of Qiu *et al*. (2003) who offered corn silage to cows with two levels of forage NDF 17% and 21%. Cows fed with 21% forage NDF had a higher proportion of acetate and a lower proportion of propionate than the cows fed with 17% forage NDF. These results are also in line with the findings of Karen A. Beauchemin (1996) who reported that increasing the NDF concentration from 32 to 40% decreased the milk yield but increased fat contents. Similar observations were also observed by Arelovich *et al.* (2008) reported that as the concentration of NDF increased over the range of 22.5 to 45.8% dietary NDF increased milk fat percentage. Similar observations were also recorded by Clark and Armentano (1997) who reported that diets with less than 16% NDF from forage depressed milk fat percentage. Likewise Karen (1996) who reported that a decrease in milk yield but increase in milk fat content by increasing NDF concentration of barley based diets ranging from 32% to 40% neutral detergent fiber

With regard to the milk protein level the concentration of milk protein was observed the highest in the group fed on diet D with 38% NDF based diet but less in group fed on diet E with 43% NDF based diet as well as in the groups with low NDF based rations A, B and C groups. Similar observations were recorded by Karen and Beauchemin (1996) who reported that milk protein was reduced with increase in NDF levels. These results are in line with the findings of Kendall *et al.* (2009) who fed diet consisting of 28% NDF produced more milk and protein than those cows who consumed diets containing 32% NDF. Similar trend was also observed in case of milk lactose found which was the highest in the group fed on diet with 38%NDF and decreased in group E with 43% NDF based diet. These results are line with the findings of Kanjanapruthipong *et al.* (2001) who reported milk protein and lactose decreased with increase in NDF concentration of ratio

Total solids in milk were highest in the group fed on diet D with 38% NDF level and lower in diet E. Similar observations were also recorded by Schwartz and Gilchrist (1975) who reported that the milk lactose, protein and total solids percentage which were reduced with the increase in roughage NDF contents. The overall results of the study indicated that higher yield of milk components is directly related to the increased supply of digestible carbohydrates provided by lower NDF based diet.

Conclusion: It may be concluded that 33% NDF in Total Mixed Ration (TMR) is optimum level for lactating Nili Ravi buffaloes for better digestibility and milk production in sub-tropical climate of Pakistan.

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