STUDIES ON PRODUCTION PERFORMANCE OF DAIRY ANIMALS USING PADDY STRAW BASED COMPLETE FEED

THESIS

Submitted to the
JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA
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in partial fulfilment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY
IN
LIVESTOCK PRODUCTION AND MANAGEMENT

~: BY :~
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JABALPUR (M.P.)
2003

 # Shri Sad Guruvey Namah #

Dedicated to My Beloved Parents

CERTIFICATE-I

This is to certify that the thesis entitled **"STUDIES ON PRODUCTION PERFORMANCE OF DAIRY ANIMALS USING PADDY STRAW BASED COMPLETE FEED"** submitted in partial fulfilment of the requirements for the degree of **"MASTER OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY"** of the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, is a record of the bonafide research work carried out by **SHRI ANJANI KUMAR MISHRA** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instructions.

No part of the thesis has been submitted for any other degree or diploma (certificate awarded etc.) or has been published / published part has been fully acknowledged. All the assistance and help received during the course of the investigation have been duly acknowledged by him.

Dr. V.P. Singh
Chairman of the Advisory Committee

THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE

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CERTIFICATE-II

This is to certify that the thesis entitled **"STUDIES ON PRODUCTION PERFORMANCE OF DAIRY ANIMALS USING PADDY STRAW BASED COMPLETE FEED"** submitted by **SHRI ANJANI KUMAR MISHRA** to the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur in partial fulfilment of the requirements for the degree of **"MASTER OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY"** in the **Department of Livestock Production and Management**, College of Veterinary Science and Animal Husbandry, Jabalpur has been approved after evaluation by the External Examiner and by the Student's Advisory Committee after an oral examination on the same.

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Date : 31/X/03

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Anjani

(Anjani Kumar Mishra)

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LIST OF ABBREVIATION

%	:	Per cent
°	:	Degree
°C	:	Degree Centigrade
°F	:	Degree Fahrenheit
A.M.	:	Ante Meridiem
Ad lib	:	*Ad libitum*
AOAC	:	Association of Official Analytical Chemist
CF	:	Crude fiber
CP	:	Crude Protein
D.M.I.	:	Dry Matter Intake
DCP	:	Digestible Crude Protein
dl	:	Desi litre
DM	:	Dry Matter
EE	:	Ether Extract
et.al.	:	And others
Fig.	:	Figure
g	:	Gram
i.e.	:	That is
JNKVV	:	Jawaharlal Nehru Krishi Vishwa Vidyalaya
Kg	:	Kilo gram
M.P.	:	Madhya Pradesh
mg	:	Milli gramme
ml	:	Milli liter
NFE	:	Nitrogen Free Extracts

nm	:	Nano metre
No.	:	Number
NRC	:	National Research Council
P.M.	:	Post Meridiem
S	:	Standard
SNF	:	Solid not fat
TDN	:	Total Digestible Nutrients
TS	:	Total Solid
Vs	:	Versus

* * * * *

Introduction

INTRODUCTION

Cattle and buffaloes have been an integral part of crop-livestock system in Indian farm economy for thousands of years. The man-land-cattle ecosystem in the country is based on natural symbiotic relationship where cattle and buffaloes have complementary, supplementary and sustainable relationship with crops. The drought power for agricultural operations and rural transport is available from cattle. Their dung production helps in providing organic manure for maintaining long term soil fertility as well as fuel for kitchen to the farm family (Patel,1997). Animal Husbandry sector accounts for over 25-26 per cent of gross value of agricultural output and meet the domestic demand for food and employment generation.

At present, India has about 210 million cattle, which is about 50 per cent of Asian and about 18 per cent of world cattle population. The current buffalo population is over 79 million, which accounts for 54 per cent of the buffalo population of Asia and 56 per cent of the world. In India crop production can generate employment for the work force for only 90 to 120 days. During the remaining period they virtually remain un-employed in which dairying sets right the imbalance in employment (Anejaand Puri, 1997). The large proportion of human population (nearly 40 per cent) is vegetarian, for which milk and milk products are of special value as they are the only source of animal protein.

In ancient time, milk production was considered a by-product of bullock drought power, but it is an important source of supplementary income and nutrition to the farm family. Availability of regular cash from the daily sale of milk helps in dairy production through purchase of

compounded feed. Crop production is also improved through purchase of farm inputs like better seeds, fertilizer, pesticides, etc. The result is that increased milk production leads to significant over-all improvement in farm production, better nutritional and living standards of rural producers and their families (Patel, 1997).

India is now the world's top milk producer with its output estimated 81 million tones. Indian dairy has chronic shortage of 23 per cent green fodder, 35 per cent dry fodder and 44 per cent in concentrate requirement. Both qualitatively and quantitatively, there exist a large gap in demand and supply of feed and fodder resource across India (Pandey, 1995). The deficit in feed nutrients in the country is to the tune of 46 per cent DCP and 44 per cent TDN. To fulfil these deficiencies Indian Council of Agricultural Research appointed a committee to study the feeding and utilization of non-conventional source of livestock feeds and agro- by products for dairy animals (Bobade *et al.*, 1998).

The low productivity of Indian livestock can be attributed to:

(i) Less number of productive animals, (ii) Shortage of quality feed, (iii) Non utilization of scientific method of feeding and (iv) Adverse climatic conditions.

In advanced countries like USA, UK and Israel, a significant development has been made by adopting complete feeding system in the ruminants where, the farmers are highly persuaded to use complete feed system instead of conventional feeding system.

According to Owen (1976) complete feed implies self feeding of uniform mixture of feed ingredients processed in such a way as to avoid differential selection by the animals, whereas Kawalkar and Patle

(1978) prepared pellet comprised of a mixture of both roughage and concentrate in different proportions to feed the animals. Raina and Raghvan (1985) also advocated pellet feeding i.e., mixture of concentrate and roughage to the animals.

Thus, realizing its importance in dairy, balanced and economic ration for feeding of animals are necessary to obtain maximum returns in terms of milk, meat and wool production. The complete feed system was introduced in the country for better and economical utilization of agro-industrial and industrial by products. Waje (1996) stated that, it increases the value of feed stuffs and also simplifies feeding, minimizes labour and maximizes automation. In this system, feed containing roughage and concentrates are blended uniformly in desired and proper ratio of roughage, concentrate and other nutrients to ensure the nutritional requirement of different categories of livestock for its various physiological functions. Senger and Naik (1996) emphasized advantages of complete feed system as discussed in following heads :

(1) Labour Saving : A complete feed may be processed, delivered and deposited in self feeder by a mechanical device. Labour, thus, saved can be devoted to managing and milking the lactating animals.

(2) Improving the low grade roughage utilization : In complete ration, it is possible to utilize low grade roughage and crop residues, which are, otherwise, of little value when fed separately. The increased intake and improved nutritive value of low quality of crop residues, due to mechanical processing is mainly attributed to reduction in its particle size. It is an important factor in complete feed formulation to understand to what extent particle size need to be reduced for improving its intake, increasing the density of feed and at the same time maintaining the

desired fat level. The feeding quality of residues and agro-industrial by-products including non-conventional feed can improve tremendously by blending them in complete feed.

(3) **Balance feeding possible :** The complete feed system not only ensures improved utilization of nutrients from crop residues and agro-industrial by-products but also helps in developing low cost balanced feeds for livestock. In *ad lib* feeding animals eat a particular feed as much as liked, refusing the unpalatable portion of the ration leading to intake of unbalanced feed, increasing wastage and feeding cost. But in complete feed, balanced feeding is ensured for increased live-stock production.

In complete feeding system with simultaneous ingestion of forage and concentrate and availability of feed all time, the animal can eat as and when it likes and this will prevent the development of acidosis also. More frequent feeding spread out the load on the rumen and maintained the normal ratio of acetic to propionic acid this favours the butter fat content in milk. Balanced feeding can be monitored in the system of feeding.

(4) **Improved growth and production :** Complete feed helps improvement of growth and production. Complete feed containing 60% mixed grass supported growth rate of 500-600g/ day (Reddy and Reddy, 1983.) whereas Waje (1996) reported that body weight gain in calves fed with complete feed as 'Sani and pellets were 400.66 and 681.16g/day.

(5) **Controlling the ration component ratio :** Controlling the ratio between various components (concentrates : roughage, Protein: energy and Calcium: Phosphorus) is a problem in livestock feeding. A precise control of various ration components for maximum growth, meat and

milk production is required, but, it is very difficult when the animals are offered to eat the component separately at free of choice and therefore, result either more consumption of concentrate or roughages leadingto disturb the ratio. In complete feed the ratio of different components is maintained by mixing them properly in mash.

(6) Easy storage : Complete feed can be formulated and processed into mash or pellets or blocks by using locally available farm crops leftover like wheat straw, paddy straw, maize straw, sugar cane bagases and fallen tree leaves etc.

Mostly animals are reared on feed stuffs, which are not consumed by human beings e.g. wheat and paddy straw and stovers of maize and sorghum etc. Thus, the animals, fed on above feed stuff, will remain either underfed or malnourished due to feeding of such in balanced ration which is being deficient in different nutrients. This ultimately affects productive and reproductive performance of animals and responsible for making economic loss to the owners.

Since country is in short supply of feed and fodder, there is need to explore new feed resources and conventional feeds which can be fed to the animals. There is scope and need for improvement of poor qualities crop residues by different processing technologies. The feeding of milch cows and buffaloes with complete feeds based on concentrates, minerals and vitamin supplements blended with available crop residues like paddy straw will improve the overall performance and health of animals.

Under the present situation improvement of stall feeding system followed by dairies near cities is found to be more practicable. The 'sani' system followed by most of the dairies suffered from the problem of

imbalance of nutrients in a ration as they do not care to supply the essential nutrients such as calcium, phosphorous, vitamins and protein in balanced way. It is, therefore, necessary to balance 'sani' system in respect of these nutrients, such ration will form a complete feed. Complete feed for different age groups of animals can be prepared and fed to the livestock. The complete feed, thus, prepared have been reported to increase the feed consumption, feed efficiency and milk production by lactating cross bred cows and buffaloes. Thus, the present work was undertaken with following objectives:

OBJECTIVES

1. To evaluate the feeding system of paddy straw and concentrate mixtures separately, and "sani" system of feeding by blending soaked paddy straw and concentrate mixture together for dairy animals under farm conditions.
2. To study the effect of above systems of feeding on production performance of dairy animals.
3. To study the effect of above system on quality and quantity of milk of dairy animals.
4. To know the digestibility coefficient of different feed by digestion trial in animals.
5. To work out the economics of milk production.
6. To develop a economically viable balanced feed prepared out of locally available concentrates and paddy straw as roughage.

Review of Literature

Complete feed

The feeding quality of crop residues like paddy straw and non-conventional feed can be improved if they are blended into complete feed. The concept of complete feed system can advantageously be applied for improving the agricultural crop residues like paddy straw for developing low cost balanced feed for ruminants.

Das . . . (2002) reported that the processing of complete feed including paddy straw, concentrates and other feed supplements in the required proportion into uniform mixture make the animals to eat every bit of offered feed and ensures the supply of all the nutrients required by animals for specific purposes.

Nocek *et al.* (1985) reported that the cows fed paddy straw or other forges and grain separately showed lowered FCM yield than the cows fed total mixed rations.

Tiwari *et al.* (1995). Found that complete feed consisting of 30 parts paddy straw, 10 parts berseem and 60 parts concentrate mixture containing maize grain, rice bran, mustard cake, common salt, mineral mixture enables better production performance than control group.

Owen (1976) mentioned the following advantage of complete feed system :

(a) With every bit, the animals gets balanced feed.

(b) Utilization of nutrients are increased.

(c) Wastage of feed is reduced.

(d) Total feed intake is increased. Recommended nutrient specifications of complete feed are mentioned below:-

S.No.	Nutrient	Lactation diet
1.	Crude protein (g/kg DM)	130.0
	(a) Rumen degradable protein (g/kg DM)	85.0
	(b) Undegradable protein (g/kg DM)	30.0
2.	Crude fibre (g/kg DM)	160-200
3.	Ether Extract (g/kg DM)	30-80
4.	Proportion of forage DM in total DM (%)	
	(a) For diet based on hay/silage	40-70
	(b) For diets based on chopped or coarsely ground straw	

Owen. 1976

Punj (1994) reported that crop residues like paddy straw and other non-conventional materials is used for feeding of animals and thus shortage of fodder can be met to a large extent.

Pal *et al.* (1999) found CP, EE, CF, NFE and total ash of paddy straw as 2.94, 1.37 37.37, 40.32 and 18 per cent respectively, whereas Das and Ghosh (2001) reported as 2.86, 1.20, 33.2, 52.88 and 10.76 per cent respectively.

Yadav *et al.* (2001) found CP, CF, EE and TA of paddy straw as 2.5, 40.95, 1.5 and 12.35 percent respectively. Reddy and Reddy (1994) mentioned that blending of concentrate and roughage into complete feed as beneficial, which improves its nutritive values.

Agnew (1996) compared the feeding of complete feed with separate feeding of fodder and concentrate to the animals and reported the feeding as complete feed to the animals is better in all respects.

Singhal *et al.* (1992) studied the effects of pelleted complete feed and chopped complete feed in cattle. Two types of pellets were fed i.e., non-treated and alkali treated. The dry matter digestibility of chopped complete feed (T1) was 74.97 ± 2.26, whereas digestibility of non-treated pelleted complete feed (T2) and alkali treated pelleted complete feed (T3) were 67.48 ± 2.47 and 64.03 ± 1.92, respectively supporting the fact that the dry matter digestibility in pellet fed groups was significantly lower than non-pellet group which may be due to higher rate of passage from rumen as a result of grinding and pelleting of straw and hay.

Puri and Gupta (1990) investigated the effect of feeding ammonia (urea) treated rice straw on dry matter digestibility in crossbred calves and showed that the paddy straw treated with 4 per cent urea + 40 per cent moisture and 5 per cent urea + 30 per cent moisture were better utilized than that treated at lower levels of urea.

Yadav *et al.* (1991) studied the effects of compaction of roughage based complete feeds on dry matter digestibility in four buffalo bulls (240-249kg) which were fed on four treatments viz., unground wheat straw (T1), ground wheat straw (T2), unground paddy straw (T3) and ground paddy straw (T4) based complete feed blocks following a 4 x 4 Latin square design. The DM digestibility was significantly ($P<0.05$) affected by the type of straws. The digestibility of these nutrients was highest in animals fed on T3 diet followed by those fed on T4, T1 and T2, and it appears that the higher lignin content in wheat straw than paddy straw was responsible in lowering of digestibility.

Patle *et al.* (1992) observed the effects of DM digestibility on two types of pelleted complete feeds in crossbred heifers. Diet I consisted of wheat (50 kg), Berseem hay (10 kg), wheat bran (25 kg), decorticated GNC (13.5 kg), mineral mixture (1 kg) and common salt (0.5 kg). Diet – II consisted of straw (40 kg), Berseem hay (20 kg), maize grain (25 kg), Decorticated GNC (13.5 kg), mineral mixture (1 kg) and common salt (0.5 kg). The predicted values of DM digestibility for diets 1 and 2 were 49.93 and 53.83, respectively, with a standard error of 1.19. These results supported the fact than DM digestibility of the present feeds (49.93 per cent for diet I and 53.83 per cent for diet 2) seem to be lower than the feeds fed conventionally (55 to 58 per cent).

Singhal *et al.* (1992) compared the DM digestibility coefficient of cattle and buffalo on ammoniated paddy straw and predicted values were 56.04 ± 1.98 for cattle and 54.48 ± 1.64 for buffaloes. He mentioned that digestibility of added nitrogen is questionable and recommended that with this type of feeding systems adequate protein supplement should be provided to animals.

Das and Kundu (1995) conducted an experiment on 12 growing male buffaloes calves and compared the DM digestibility values of 3 rations T_1 containing wheat straw, T_2 containing wheat straw treated with 2 per cent Ca (OH)2 + 1 per cent NaOH and T_3 containing wheat straw treated with 4% urea. The observed digestibility was 52.50 ± 0.68, 42.30 ± 2.80 and 53.05 ± 0.62 for T_1, T_2 and T_3 groups respectively, which was higher in T_1 and T_3 than in T_2. Misra *et al.* (1995) conducted an experiment with 24 crossbred heifers, which were divided in to 4 equal groups and fed restricted (1.8 per cent b. wt.) and *ad libitum* quantity of treated wheat and paddy straw along with concentrate mixture to meet their remaining protein and energy

requirements. In addition, each animal was also fed 2 kg green sorghum, 30 g each of mineral mixture and common salt. They dry matter digestibility coefficients for restricted feeding T1 and T2 were 49.28 and 51.32, respectively, and DM digestibility coefficients for *ad libitum* feeding T3 and T4 were 45.24 and 47.24,respectively. The digestibility coefficients of DM differed significantly ($P<0.05$) between restricted and *ad libitum* feeding and was non-significantly different at the same level of feeding stating that restricted feeding is useful in increasing the DM digestibility of urea treated wheat the rice straw based rations.

Bhadoria and Singh (1997) found a higher DMD value of teak leaves treated with 4 per cent lime and 1 per cent urea than leaves treated with water and 4 per cent lime of treated with water and 1 per cent urea.

Pachauri *et al.* (1999) noted that feeding of unprocessed and densified dry grass in two groups of crossbred calves respectively had no significant difference in respect to DM digestibility.

Sengar *et al.* (1999) conducted an experiment on 8 buffalo heifers divided randomly into two groups and fed on complete feed based on paddy straw. Complete feed-1 consisted of 37 parts (4 per cent urea treated) paddy straw, 3 parts green, 6 parts deoiled mustard cake, 41 parts deoiled rice bran, 10 parts molasses, 2 parts mineral mixture and 1 part common salt. In complete feed-2, in place of deoiled mustard cake, 7 parts of deoiled undecorticated cotton seed cake plus 0.2 parts of urea were added and deoiled rice bran was reduced by 0.2 parts. The dry matter digestibility coefficients for complete feed 1 and 2 were 55.50 ± 2.08 and 56.37 ± 0.74, respectively, indicating that any of the (N) sources under test can be incorporated in the complete feed depending upon their price and availability.

Sureshkumar *et al.* (2000) studied the DM digestibility on Murrah buffalo heifers, divided into 3 groups which were fed 3 different complete diets containing 50, 60 and 70 per cent ammoniated straw and 37, 27, 17 per cent deoiled rice bran in group I, II and III, respectively. Dry matter digestibility coefficients for group I, II and III were estimated as 55.55 ± 1.80, 50.25 ± 0.54 and 50.36 ± 0.90, respectively, indicating that the three diets were almost similar in nutrient utilization and it was concluded that ammoniated wheat straw to the extent of 70 per cent may be more economical in the diet of buffalo heifers.

Kaur and Kaushal (2001) studied the effect of water, NaOH and urea treatments on dry matter digestibility of straws in ruminants and found the mean DMD of untreated bagasse was 26.49 per cent, which was increased to 54.46 per cent after treatment with 5 per cent NaOH. With increasing levels of NaOH, the maximum improvement in DMD was 29 units with corresponding improvement of 16 units with urea treatment suggesting 150 ml/100 gm DM moisture levels was the most appropriate. However, after 4 per cent level of NaOH, and urea, the rate of improvement in DMD diminished.

Puri and Gupta (1990) calculated the N balance (g/d) in crossbred calves fed on untreated (A); urea + 40% moisture treated (B) and 55 urea + 35 moisture treated (C) Paddy straw as basal roughage and the observed values were 22.66 ± 0.99; 28.10 ± 0.71 and 27.74 ± 0.65 for groups A, B and C respectively. Thus it can be inferred that the treatment of paddy straw at 4% level of urea was more effective than at 55 level of urea.

Khandaker and Tareque (1999) studied the effect of paddy straw based diet with varying levels of rumen degradable protein (RDP) from urea on TVFA concentration in vitro. Animals were fed four diets

containing RDP levels of subsequently 50, 75, 100 and 150 per cent in urea diets U0, U1, U2 and U3 groups respectively. TVFA concentration was significantly ($P<0.01$) higher on diet U2 than other diets (U0, U1 and U3). The TVFA concentration peaked at 5 hr post feeding. The results thus indicated that straw based diet containing 100 per cent RDP was superior than other RDP levels when urea as RDP supplement.

Yadav et al. (1991) formulated complete feeds containing 76 per cent straw with wheat straw and paddy straw both in chopped and ground forms. The unground forms of both the straws were better than ground forms of respect in straw, as it resulted in more durable blocks. Between the straws, paddy straw resulted in more durable blocks than wheat straw.

Effect of different diets on digestibility

Yadav and Yadav (1990) studied the digestibilities of four adult cattle feed 4 having, untreated wheat straw (T1), urea-ammoniated wheat straw (T1), untreated paddy straw (T3) and urea-ammoniated paddy straw (T4) with varying levels of concentrate mixture. The digestibilities of (OM) was significantly ($P<0.01$) higher in animals fed urea-ammoniated straw than untreated straw, indicating the superiority of urea-ammoniated straw over untreated straw diet.

According to Sohane *et al.* (1999) paddy straw is a most abundantly available crop residue in India. Farmers use straw from different cultivators of paddy grown on the farm for feeding of animals. Straw of different paddy varieties varies in their digestibility and intake and such variation may be attributed the genetic make up of the plant.

Singhal *et al.* (1992) studied the comparative digestibility of ammoniated paddy straw in cattle and buffaloes and stated that the digestibility coefficients were similar in both the species.

Verma, *et al.* (1995) reported that 4 per cent urea treatment of paddy straw significantly improved the nutritive value of paddy straw significantly. The improvement was higher by urea ammoniation of paddy straw. The results indicated that urea ammoniation of paddy straw could profitably constitute an efficient basal roughage for growing buffalo calves. Chaturvedi and Tiwari (1997) conducted a growth cum digestibility trial for 90 days in 24 cross bred heifers and he reported that the treatment of paddy straw improved its feeding value.

Das and Ghosh (2001) conducted an experiment to evaluate the digestibility I lactating crossbred cows fed concentrate supplements and pasture. Group 1 (control) were stall fed on paddy straw, thin napier grass and concentrates as per their requirements. Other groups were on grazing for 6 h/d besides providing paddy straw and concentrate supplementation @ 1, 2 and 3 kg in group II (T1), III (T2) and IV (T3), respectively. The digestibility was observed that 66.76, 71.86 and 66.26 per cent in control, T1, T2 and T3 groups respectively and variation among groups was significant ($P<0.01$). This is indicated that 2 kg concentrate supplementation could be optimum for cows producing 7 kg milk/d grazing on pasture.

Kalita, *et al.* (1998) reported that feeding of urea treated paddy straw was more economical compared to the feeding of untreated or water soaked paddy straw.

Sundstol *et al.* (1978) also mentioned a better per kg body weight gain, cost wise with ration containing paddy straw blended with suitable concentrate ingredients.

Nisal (2000) reported that digestibility co-efficient for CP were higher in complete feed group (65.2%) compared to control groups fed conventional diets (46.1%). By feeding complete feed there was improvement in DM intake, protein utilization and growth rate.

Dahiya, *et al.* (1998) mentioned that voluntary feed intake and digestibility of DM, CF and NFE were more in treated straw than untreated straw and these straws when fed *ad-lib* can met the maintenance requirement of buffalo bullocks.

Reddy *et al.* (1996) reported that voluntary feed intake, digestibilities of dry matter, crude protein, organic matter and total digestible nutrients was significantly ($P<0.05$) higher on fodder base complete diet than conventional diet.

Sriramamurthy *et al.* (1992) observed significantly ($P<0.05$) higher organic matter, ether extract and nitrogen free extract digestibility on complete diet.

Reddy *et al.* (1988) reported significantly ($P<0.05$) higher DM, CP and NFE digestibility on complete diet based on roughages than that of conventional diet.

Satyanarayana Reddy (1992) found significantly ($P<0.05$) higher dry matter intake on complete diet and which might be due to higher palatability of feed due to processing and blending of concentrates with poor quality roughages and also due to rapid rate of passage of diegesta.

Waje (1996) reported that dry matter intake and digestibility of different organic nutrients were significantly ($P<0.05$) higher on complete diet than conventional diet.

(C) Effect On Milk Production and Quality

Reddy *et al.* (1994) compared sunflower based complete diet with conventional diet fed to cross-bred cows and reported that total milk and fat corrected milk yield, fat yield & SNF yield was significantly ($P<0.05$) higher on complete diet than conventional diet.

Reddy *et al.* (1988) reported higher 4 per cent FCM yield on sunflower based complete diet than conventional diet fed to cross bred cows.

Marshal and Voigt (1975) found that milk composition and yield did not differ significantly when ration contain comparable portion of corn silage and concentrate mixture were fed *ad. libitum* as an ensiled complete ration or a complete ration blended at the time of feeding or as separate component in switch back type experiment.

Reddy (1986) observed that 45 per cent cotton straw or 47.5 per cent mixed ground hay in complete feed given to cross-bred cows or Murrah buffaloes maintained milk production of 6 to 8 litres with normal butter fat levels compared with conventional type of feeding.

Muller and Botha (1998) fed twice daily on and like basis a complete diet providing 15 per cent CP, 13 per cent CF and 10.8 per cent MJ Me/kg DM to Holstein-Fresian and Jersey cows and found that Holstein Fresian cows produced more milk per day than Jersey and also had higher feed and water intake.

Kawalkar *et al.* (1998) compared two complete rations with conventional ration fed to cross-bred cows and reported that milk yield, FCM yield and S.N.F. yield were significantly ($p<.001$) higher for complete few than conventional ration.

(D) Economics of Milk Production

The major item on expenditure for any livestock industry is the in-vestment on feed of animals.

According to Panse *et al.* (1991) feed cost of dairy animals maintained at Delhi was 64.7 per cent of total expenditure. Similar observation was also recorded by dairy farm of National Dairy Research Institute, Karnal, they observed that cost of feeding was, further, reduced without adversely affecting the milk production when fodder based feeding was practiced.

Singh *et al.* (1983) studied the effect of complete feeding system on productive performance of buffalo calves, and found that higher feed conversion efficiency in the complete diet feeding system (2-2.2) than the control group (2-4) resulted in higher daily body gam in the experimental groups than the complete feed was (10.81-15.77) more economical than the conventional system.

According to Mc Cullough (1994) an optimum ration for dairy cows were designed to provide adequate quantities of nutrients balanced in a manner to supply necessary precursors for the production of the inherited volume of milk with its appropriate milk constituents. Complete feed system not only improves the feeding value of feed stuff but also simplifies feeding, minimizes labour and maximizes automation. It makes animal to eat whatever is offered as well as ensures the supply of all necessary nutrients even poor quality roughages, unconventional feed stuffs and non protein nitrogenous sources can be utilized better. Thus cost of feeding can be reduced.

Materials & Methods

MATERIALS AND METHODS

The study was carried out on crossbred cows and Murrah lactating buffaloes maintained at Livestock Farm, Adhartal, JNKVV, Jabalpur (M.P.). The livestock farm is situated at the side of National Highway No. 7 on the tropic of cancer at 80^0 latitude at the elevation of 410.8 meter above sea level. The climate is light tropical, sub-humid with a seasonal variation in temperature and rainfall. The annual rainfall ranges from 1250-1400 mm, most of which received during July to September with occasional winter showers. The summer temperature seldom goes up to 45^0C and in winter it will be as low as 4^0C. The soil is heavy black clay with uniform topography.

The experiment was conducted from March 10^{th} to June 7^{th}, 2003 during summer season. The average maximum and minimum temperature was in summer season 45^0C and 26.15^0C , whereas humidity was 10.9%.

Selection of animals

18 crossbred dairy cows and buffaloes which were freshly calved, were selected considering their parity, milk yield, stage of lactation and body weight. The animals were divided into three groups of having six animals each. The animals were randomly distributed in each group.

The dietary groups are as follows :

(a) Group - I: The animals were fed normal conventional ration, which is being fed to other milch animals at Livestock Farm.

(b) Group - II: The animals were fed chaffed paddy straw and concentrate feed separately.

(c) Group - III: The animals were fed in the form of 'sani', which was prepared by chaffed paddy straw soaked in water overnight and blended with concentrate mixture.

Duration of Experimental period

Duration of experiment was 90 days (from March 10 to June 7, 2003) before the actual start of the experiment, there was 10 days of pre experiment period to eliminate residual effect of previous feed.

Housing and Management

All the experimental animals were housed in a well ventilated shed under uniform management conditions. Animals taking the different treatment were tied by neck chain side by side with freedom to move freely but taking care not to eat other's feeds; and space for one animal was left vacant between each animal. The animals were driven to the adjoining paddock every morning after milking from 7:00 A.M. to 10:00 A.M.; and in the afternoon from 2:00 to 4:00 P.M. for exercise, for detection of heat and for drinking water. Cleaning and bathing of animals was practiced in the morning and shade was cleaned both in the morning and in the afternoon. The animals were hand milked in the morning starting from 6:00 A.M. and in the evening from 5:00 P.M. Individual milk record of both morning and evening of each animal was maintained.

Table : 1 Details of experimental animals

Treatment groups	Animal No.	Date of calving	Parity	Milk prod. Lit/day
Buffalo	B 90	11-1-03	3rd	7.3
	B 92	5-2-03	2nd	9.7
	B 97	21-10-02	4th	8.5
Cows	C 1003	6-1-03	2nd	9.2
	C 559	5-1-03	3rd	10.5
	Bx 104	21-1-03	4th	10.0
Mean				9.78
Group II				
Buffalo	B 91	3-2-03	3rd	8.5
	B 94	22-1-03	2nd	9.3
	B 99	17-2-03	4th	8.5
Cows	C 920	4-1-03	3rd	8.8
	C 764	1-3-03	4th	10.0
	C 621	1-3-03	4th	13.8
Mean				9.81
Group III				
Buffalo	B 93	20-1-03	3rd	9.4
	B 95	15-2-03	3rd	6.4
	B 100	1-3-03	4th	9.0
Cows	C 870	2-3-03	2nd	10.8
	C 638	6-1-03	4th	12.8
	C Ay 19	25-12-03	4th	11.5
Mean				9.95

Preparation of complete feed as 'Sani'

Concentrate mixture were prepared as per formula given in Table 2. Then a thin layer of weighed amount of chaffed and soaked over night paddy straw was spread on concrete floor over which above prepared concentrate mixture was also spread evenly and then paddy straw and concentrate mixture was mixed to form a homogenized complete feed mixture . Water was admixed to it in a proportion of 1:2.

Preparation of Concentration Mixture

Concentrate mixture for conventional feeding and experimental feed was prepared by mixing ground feed ingredients manually as per formula given in Table 2.

Table 2 : Composition of Experimental diets (kg)

S.No.	Ingredients	Concentrate Mixture used in (control)	Concentrate Mixture used	Complete feed as sani
		Group I	Group II	Group III
1.	Maize	15	15	19
2.	Deoiled Rice bran	28	27	5
3.	Wheat bran	20	10	-
4.	Urd Chuni	20	15	14
5.	Mustard Cake	15	15	15
6.	Ramtil Cake	-	15	5
7.	Mineral mixture	1	1	1
8.	Salt	1	2	2
9.	Paddy straw	-	-	40
	DCP TDN	13.68 68.03	15.66 70.75	13.2 65.8
	Roughage : Concentrate Ratio	45:55	45:55	40:60

Digestion Trial

The animal shed was washed thoroughly with water and phenyl prior to the digestion trial. After the 60 days of experimental period, 5 days collection period was conducted on all experimental cows. Faeces was collected manually and kept in the well lebelled and weighed tin separately for each cow. Round the clock vigilance was kept to ensure that entire amount of dung voided out was collected.

Every day at 9:00 hrs the dung voided out during 24 hours was weighed accurately. It was mixed thoroughly by rubbing on palm and then a homogenous sample was taken in plastic container separately for each cow. In the laboratory the upper layer of dung sample was removed and from remaining portion of 1/100th of total faeces voided out by each animal was weighed in shallow iron trays. The samples were well spread in the trays for individual animal and kept in hot air oven for dry matter determination.

For determination of nitrogen 1/1000th of the total faeces voided was weighed in a watch glass and after mixing with 5 ml of 25 percent sulphuric acid (preservative), it was transferred to previously weighed and lebelled wide mouth glass bottles. The bottles were stoppered well. Such samples were pooled for five days. At the end of collection period the preserved faeces in the bottle was mixed well and an aliquot from this in duplicate was used for nitrogen determination.

Method of proximate analysis

Dry matter estimation: Dry matter of feeds was estimated by drying the samples at 100^{0}C for 24 hours in hot air oven to avoid losses of volatile acids, alcohol, aldehyde and nitrogen free extract from faeces, the sample

were dried at 65°C for 24 hours and weighed. The crust over the top of the faecal samples was broken after drying had proceeded for a period of four hrs. Upon completion of drying under above condition the seven days samples were pooled together and allowed to air dry for about a week. The duplicate of each sample was ground together in a micro willey mill through a 40 mesh sieve to obtain the sample for determination of hygroscopic moisture, ash, ether extract, crude protein and crude fiber.

Nitrogen Estimation : The ground samples of feeds and faecal samples (preserved in 40% sulphuric acid) were used for nitrogen estimation using Gerhadt gel tech method. Crude fat was estimated using petroleum ether (40-60°C) by Kel plus method. Crude fiber was estimated by boiling fat free samples in 1.25% sulphuric acid and then 1.25% sodium hydroxide upto half an hour for each boiling. Ash was estimated by burning the samples in muffle furnace at 600°C (AOAC, 1995).

Table :3 Proximate composition of feed ingredients and experimental feeds (% DM Basis).

Feed ingredient	DM	CP	EE	CF	NFE	Ash
Wheat straw	90.0	3.05	1.94	36.75	45.96	12.30
Paddy straw	90.5	2.27	1.05	35.50	44.90	16.80
Maize grain	90.2	10.23	1.24	2.11	82.92	7.4
Deoiled rice polish	92.12	9.86	3.00	17.00	52.00	14.00
Wheat bran	91.05	12.01	1.8	12.46	66.90	5.06
Mustard cake	91.90	32.01	11.00	10.00	33.80	10.80
Ramtil cake	92.00	28.01	10.20	13.50	29.40	11.00
Urd chuni	90.00	11.74	3.59	20.17	53.94	12.31
Conc. Mixture	91.00	15.66	3.38	14.98	57.96	7.92
Complete feed 'Sani'	65.00	13.30	3.95	23.41	46.36	13.08

Estimation of milk constituents

The milk yield of each animal was recorded both in the morning and in the afternoon to get daily milk yield of each animal; from which average daily milk of each week, each month and the whole experiment period were calculated.

Milk samples were taken fortnightly from each cow for estimation. From each milking at morning and evening 75 ml of milk was sampled and thus two samples were bulked to provide one day sample. Out of these pooled samples, representative sample was taken for analysis of fat and solid-not-fat.

The fat percentage was estimated by Gerber's method (Aggarwala and Sharma, 1961). The solid-not-fat percentage was estimated by calculation from fat percentage and gravity reading.

Observations

During the experiment, the following observations were recorded:

1. Proximate composition of experimental feed.
2. Daily feed intake
3. Daily milk yield
4. Fortnightly milk composition
5. Digestion trial at 60 days of experiments
6. Economics of milk production (Feed cost/kg of milk yield)

Economics of Milk Production

To calculate cost of feeding, first average unit price of concentrate mixture, paddy straw was calculated and then multiplied by the amount of

each feed consumed (as such bases) by individual animal during the whole experiment period to get total feed cost. The total feed cost was then divided by the corresponding milk production of each animals to obtain feed cost per litre of milk production of each animal; from which group averages were calculated. For calculation of cost milk production, all costs incurred for each animals during experiment period were calculated; and total cost was divided by total milk production which then the averages were calculated.

Statistical Analysis

The layout of the experiment was done in factorial design (CRD) with two factors i.e. two species (Cow and Buffalo) of animals and three levels of feed groups (Group I normal conventional ration, Group II chaffed paddy straw and concentrate feed separately, Group III chaffed paddy straw soaked in water overnight and blended with concentrate mixture). Each treatment was replicated three times.

The data was analyzed by Analysis of variance (ANOVA) as per standard procedure (Snedecor and Cochran, 1989).

Results

RESULTS

Proximate composition of experimental feeds

The proximate composition of feeding stuffs offered to the lactating cows and buffaloes are presented in table 4. Crude proteins of concentrate mixture and complete feed sani were estimated as 15.66 and 13.30 percent, respectively.

The DM, CP, EE, CF, NFE and Ash of concentrate mixture were estimated as 90.0, 15.66 3.38, 14.98, 57.96 and 7.92, respectively, while the corresponding figures of these nutrients were found as 65.0, 13.30, 3.95, 23.41, 46.31 and 13.08 percent, respectively, in group III, where animals were fed feed and fodder together mixed in the form of sani.

The proximate composition of paddy straw was calculated and its DM, CP, EE, CF, NFE and Ash were found as 90.50, 2.25, 1.05, 35.56, 44.50 and 16.80 percent, respectively.

Roughage concentrate ratio

The data of roughage concentrate ratio for the cows and buffaloes fed using conventional feed and complete feed sani are tabulated in table 5. The roughage concentrate ratio was 45 :55 in groups I and II, whereas roughage and concentrate ratio of complete feed sani was 40 : 60 in group III.

Daily feed and dry matter intake

The data on daily feed intake and dry matter intake (DMI) of animals maintained under groups I,II, and III are presented in table 6.

Table 4: Proximate composition of experimental feed (% DM Basis).

Feed ingredient	DM	CP	EE	CF	NFE	Ash
Conc. Mixture	91.00	15.66	3.38	14.98	57.96	7.92
Complete feed 'Sani'	65.00	13.30	3.95	23.41	46.36	13.08
Paddy straw	90.5	2.27	1.05	35.50	44.90	16.80

Table 5 :Roughage concentrate ratio for the experimental groups

Groups	R:C
I	45: 55
II	45:55
III	40:60

The average daily feed intake (kg) of buffaloes was observed 14.74 ± 2.08, 14.52 ±1.32 and 16.72 ± 0.89, for group I,II and III, respectively, whereas daily dry matter intake of these groups were calculated as 13.41±0.07, 13.21±0.86 and 11.32±1.04, respectively . The average daily dry matter intake (kg) of cows was observed 11.17±1.26, 11.77±1.56 and 12.01±1.03, while in buffalo it was 10.16±0.97, 10.71±1.26 and 9.80±1.12, for group I, II, and III, respectively.

The feed intake of cows and buffaloes of group I and II were more or less similar, but significantly lower ($P<0.05$) than those of group III. but the average daily dry mater intake in cows and buffaloes for treatments I and II are almost similar but significantly higher ($P<0.05$) than those of group III.

Milk yield and composition

Values of daily milk yield, fat, Solid not fat (SNF) and Total solid (TS) experimental cows and buffaloes are presented in table 7 and 8.

The average daily milk yield (litre) of cows of group I, II and III were observed as 7.38 ± 0.90, 7.80 ± 0.86 and 8 .68 ± 0.41 litres, respectively, while corresponding figures of buffaloes of group I, II and III, were estimated as 5.90 ± 0.59, 5.95 ± 0.86 and 7.18 ± 0.81 litres, respectively, indicating significantly higher milk yield ($P<0.05$) in animals of group III which were fed in the form of sani. in cows and buffaloes both.

Table 6: Average daily feed and dry matter intake of experimental animals

Groups	Cows		Buffalo	
	Feed Intake (Kg)	DM Intake (Kg)	Feed Intake (Kg)	DM Intake (Kg)
I	$11.17^{b} \pm 1.26$	$10.16^{a} \pm 0.97$	$14.74^{b} \pm 2.08$	$13.41^{a} \pm 0.79$
II	$11.77^{ab} \pm 1.56$	$10.71^{a} \pm 1.26$	$14.52^{b} \pm 1.32$	$13.21^{a} \pm 0.86$
III	$12.01^{a} \pm 1.03$	$9.80^{b} \pm 1.12$	$16.72^{a} \pm 0.89$	$11.32^{b} \pm 1.04$

Table 7: Average daily milk yield and milk composition of experimental animals

Parameter	I		II		III	
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo
Milk yield (litres)	7.40 ± 0.90	5.93 ± 0.59	7.50 ± 0.76	5.99 ± 0.86	8.91 ± 0.41	7.39 ± 0.81
Fat %	4.60 ± 0.12	6.68 ± 0.07	3.94 ± 0.17	6.84 ± 0.97	3.74± 0.59	6.86 ± 0.04
SNF%	8.56 ±. 0.32	9.71 ± 0.08	8.66 ±0. 76	9.64 ± 0.07	8.73 ± 0.97	9.93 ± 0.57
T.S. %	12.71 ±0.03	16.34 ± 0.67	12.67 ± 0.03	16.54 ± 0.17	12.81 ±.0.40	16.76 ± 0.71

The average fat percent in milk of the cows of groups I, II and III were estimated as 4.6 ± 0.12, 3.94 ± 0.17 and 3.74 ± 0.59, respectively, while the corresponding values of fat content in buffalo milk were 6.68 ± 0.06, 6.84 ± 0.97 and 6.86 ± 0.04, respectively. The differences in fat content were insignificant between different groups of concerned buffaloes.

The SNF content in the milk of cows fed group I, II and III were 8.56 ± 0.31, 8.66 ± 0.76 and 8.73 ± 0.97 whereas in the buffaloes SNF contents were observed as 9.71 ± 0.08, 9.64 + 0.07 and 9.93 ± 0.57, respectively, in group I, II and III. The values did not differ significantly among the different treatment groups of animals.

The total solid content in the milk of cows was 12.71 ± 0.03, 12.67 ± 0.03, 12.81 ± 0.40 in group I, II and III, respectively, similarly in buffaloes milk T.S. content were 16.34 ± 0.67, 16.54 ± 0.17 and 16.76 ± 0.71 in group I, II and III, respectively, showing no significant difference in total solid in milk of cow and buffaloes between treatment groups.

Digestibility of nutrients

The average digestibility coefficients of different nutrients are depicted in table 9.

Digestibility of dry matter in the group I, II and III was 54.26 ± 0.36, 48.94 ± 0.76 and 59.58 ± 0.60, respectively, for cows while the same observed among buffaloes were 58.20 ± 0.61, 50.16 + 0.64 and 62.28 ± 0.76, respectively. The significant ($P<0.05$) difference were observed among the treatment groups, however, in group III, the digestibility of dry matter in cows and buffaloes were significantly ($P<0.05$) higher.

Figure 1 : Average daily feed intake of experimental animals

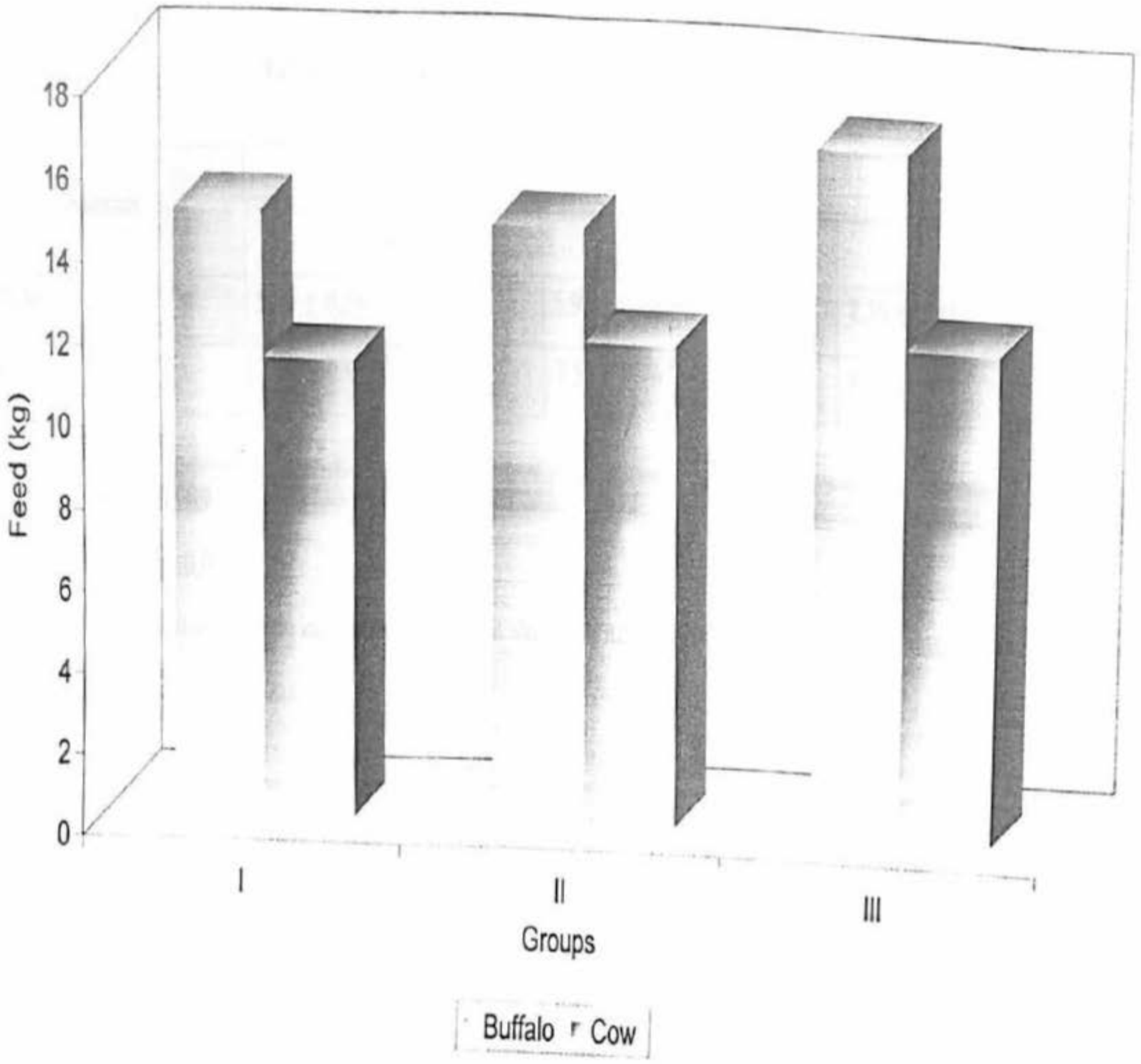

Table 8 : Average daily milk yield of experimental animals

Species	Groups		
	I	II	III
Buffalo	5.93 ± 0.59^{b}	5.99 ± 0.86^{b}	7.39 ± 0.81^{b}
Cow	7.40 ± 0.09^{b}	7.50 ± 0.76^{ab}	8.91 ± 0.41^{a}

SEM = 0.289

at = $p<0.05$

a,b,c = values bearing different superscript shows significant ($p<0.05$) difference among themselves.

Figure 2 : Average daily milk yields of dairy animals during experiment

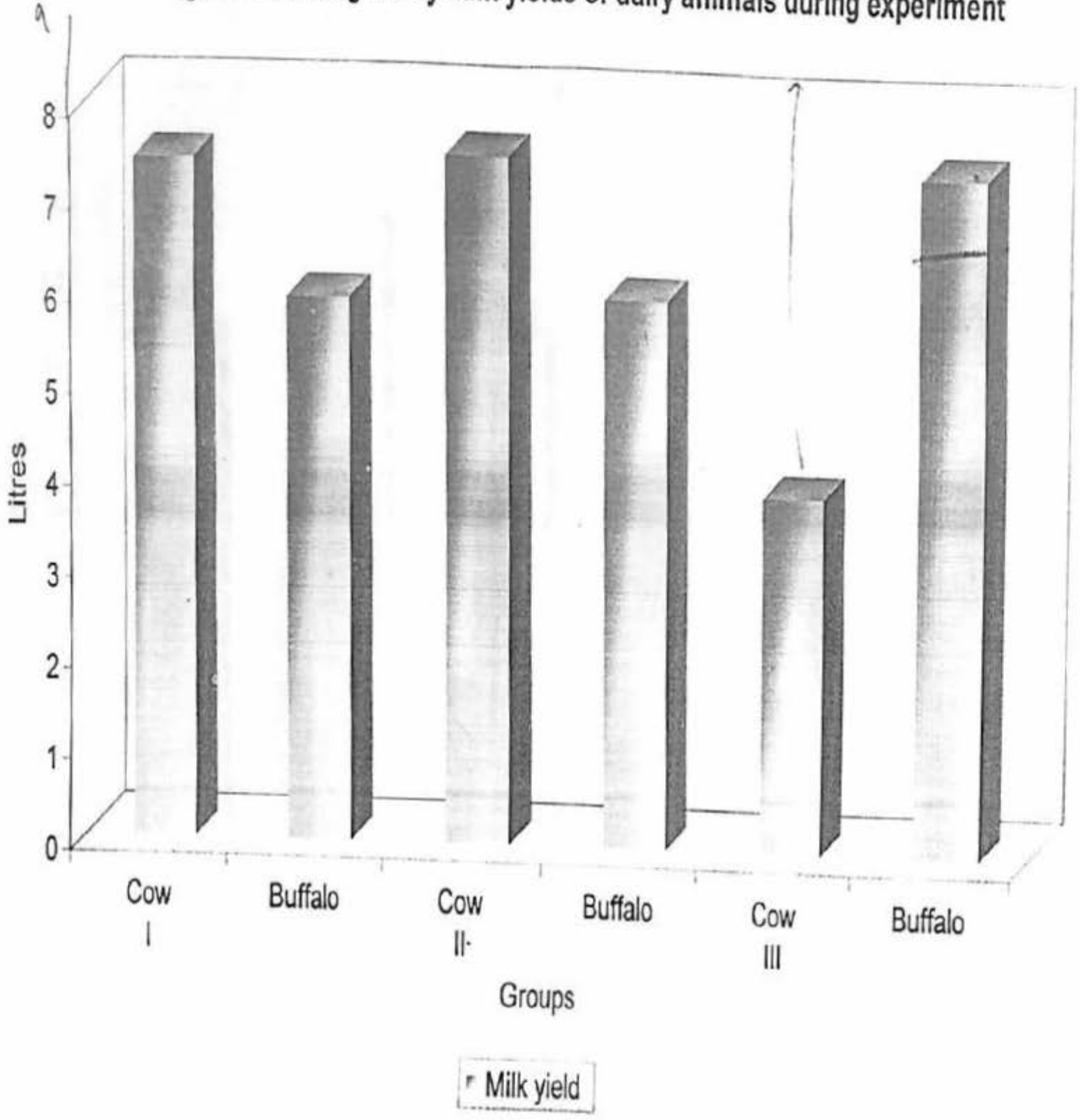

Figure 3 : Milk composition of dairy animals during experiment

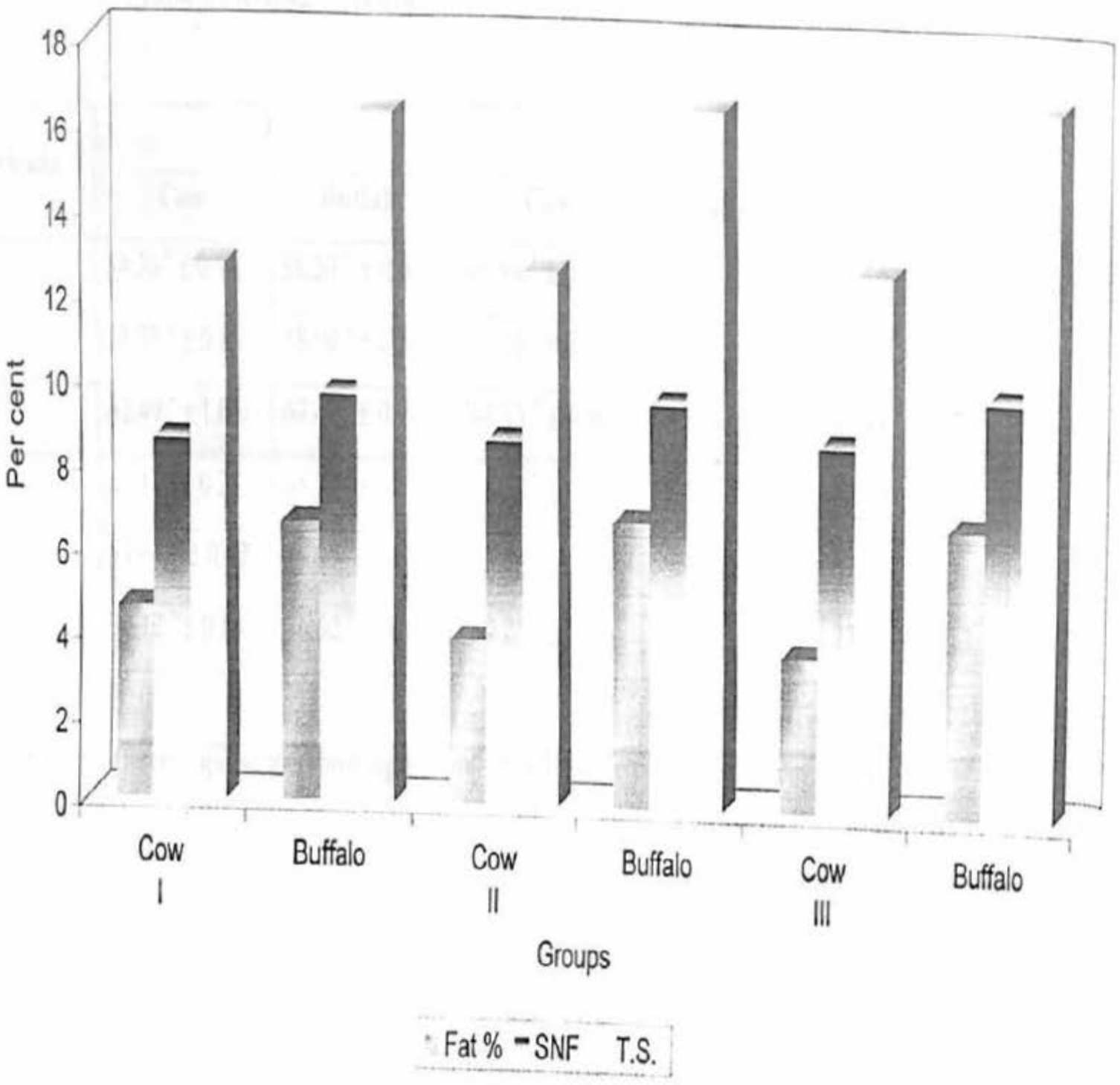

Table 9 : Average digestibility coefficient of nutrients of experimental animals

Nutrients	I		II		III	
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo
DM	$54.26^{b} \pm 0.36$	$58.20^{b} \pm 0.61$	$48.94^{c} \pm 0.76$	$50.16^{c} \pm 0.64$	$59.58^{a} \pm 0.60$	$62.28^{a} \pm 0.76$
CP	$56.75^{a} \pm 0.83$	$58.90^{a} \pm 0.50$	$47.95^{b} \pm 0.56$	$50.55^{b} \pm 0.15$	$57.56^{a} \pm 0.50$	$58.99^{a} \pm 0.58$
EE	$62.49^{a} \pm 1.0$	$67.47^{a} \pm 0.20$	$44.33^{b} \pm 0.90$	$48.32^{b} \pm 1.0$	$63.49^{a} \pm 0.16$	$67.24^{a} \pm 0.35$
CF	$61.17^{b} \pm 0.22$	$65.73^{a} \pm 0.32$	$55.38^{c} \pm 0.62$	$58.49^{b} \pm 0.22$	$63.25^{a} \pm 0.30$	$66.31^{a} \pm 0.63$
NFE	$54.64^{ab} \pm 0.67$	$56.09^{b} \pm 1.1$	$53.54^{ab} \pm 0.13$	$59.17^{b} \pm 1.0$	$57.86^{a} \pm 1.1$	$61.92^{a} \pm 1.7$
Ash	$30.12^{a} \pm 0.84$	$36.62^{a} \pm 0.74$	$30.25^{a} \pm 0.80$	$35.92^{a} \pm 0.82$	$27.56^{b} \pm 0.13$	$38.44^{a} \pm 0.28$

Values bearing different superscripts show significant ($p<0.05$) difference among them selves.

The digestibility coefficient of crude protein of cows fed on conventional feed, roughage and concentrate separately and complete feed sani were as estimated as 56.75 ± 0.83, 47.95 ± 0.56 and 57.56 ± 0.58, respectively, for cows while, the same were 58.90 ± 0.50, 50.55 ± 0.15 and 58.99 ± 0.58, respectively, in buffaloes, groups, indicating significant ($P<0.05$) difference among themselves. There was significantly ($P<0.05$) lower CP digestibility, in which roughage and concentrate were consumed separately.

The digestibility coefficient of ether extract for group I, II and III was 62.49 ± 1.0, 44.33 ± 0.90 and 63. 49 ± 0.16, respectively, in cows, while in buffaloes it was 67.47 ± 0.20, 48.31 ± 1.0 and 67.24 ± 0.35, respectively. In all three groups difference were found significant ($P<0.05$) among themselves, however group II was significantly, ($P<0.05$) lower in EE digestibility coefficient both in cows and buffaloes.

Crude fibre digestibility was 61.17 ± 0.22, 55.38 ± 0.62 and 63.25 ± 0.30, respectively, in all three groups cows, whereas the same observed were 65.73 ± 0.32, 58.49 ± 0.22 and 66.31 ± 0.63, respectively, in I, II and III groups buffaloes. Higher crude fibre digestibility ($P<0.05$) was observed in 3rd group of both species.

Digestibility of nitrogen free extract in group I, II and III was 54.64 ± 0.67, 53.54 ± 0.13 and 57.86 ± 1.1, respectively, in cows whereas in buffaloes it was 55.09 ± 1.1, 59.17 ± 1.0 and 61.92 ± 1.7, in all respective groups. All the three groups were significantly ($P<0.05$) different.

Figure 4 : Digestibility coefficients of nutrients of experimental animals

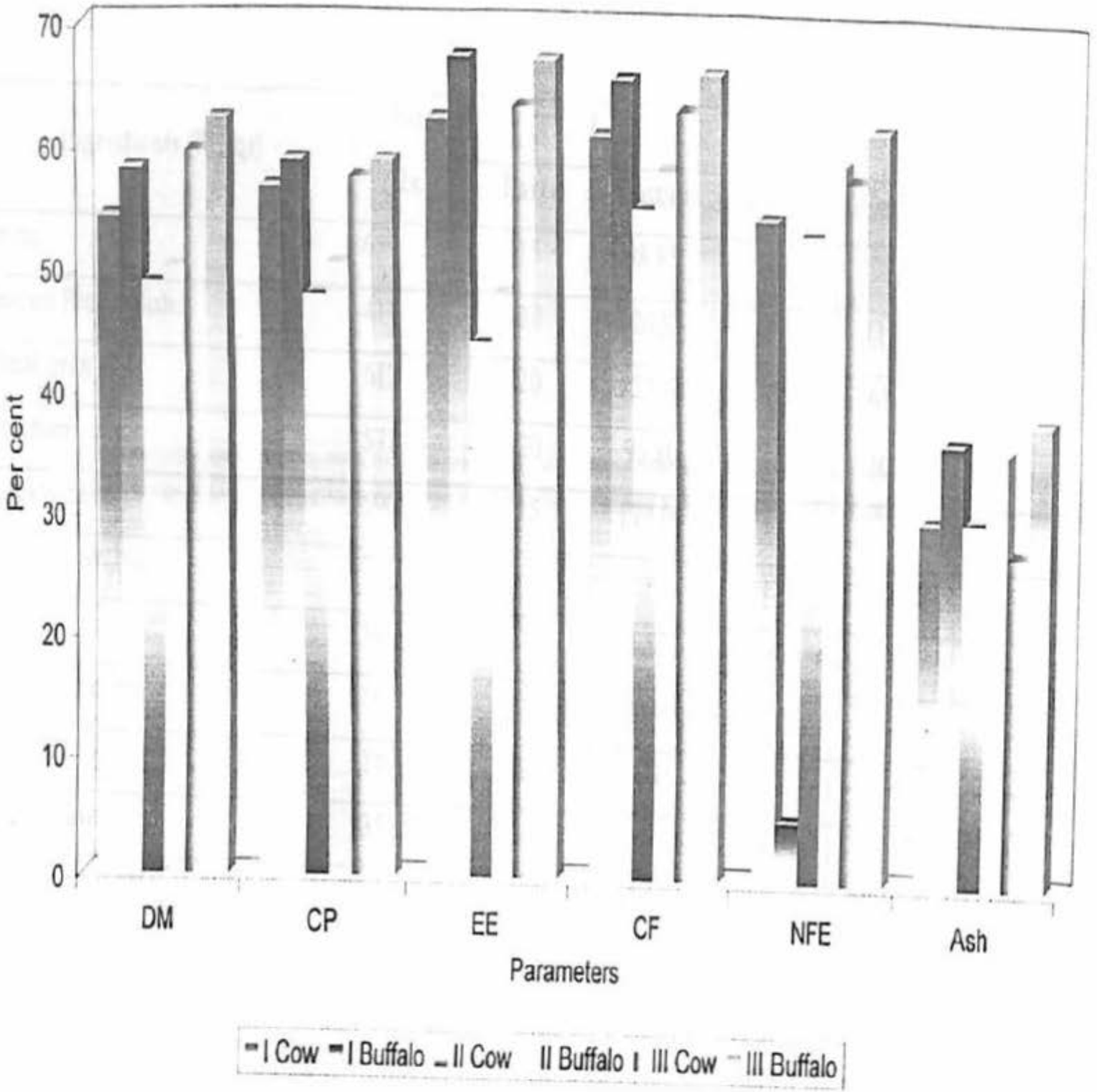

Table 10: Cost of one kg feed fed to dairy animals (Rs) on DM basis

Ingredients (Per qt)	Rate Rs.	I		II		III	
		Parts	Cost/qt	Parts	Cost/qt	Parts	Cost/qt
Maize	659	15	98.85	15	98.85	19	98.85
Deoiled Rice polish	411	28	120.97	27	110.97	5	110.97
Wheat bran	617	20	123.40	10	61.70	-	
Urd chuni	577	20	95.80	15	36.85	14	36.85
Mustard cake	590	15	177.00	15	177.00	15	177.00
Ramtil cake	707	-	-	15	106.05	4	28. 00
Salt	197	1	1.97	1	1.97	1	1.97
Mineral mixture	1690	1	16.90	1	33.80	2	33.80
Wheat straw	140	45	63	-	-	-	
Paddy straw	35/qt	-	-	45	15.75	40	14.00
Total Cost/ quintal		100	673.00	100	596.00	100	551.17

Ash content digestibility for group I, II and III was 30.12 ± 0.84, 30.25 ± 0.80 and 27.65 ± 0.13, respectively, in cows, whereas, in buffaloes ash digestibility was 36.62 ± 0.74 , 35.92 ± 0.82 and 38.44 ± 0.28, respectively. The difference in digestibility coefficient of Ash in group I and III was non significant ($P<0.05$) but group II showed significantly ($P<0.05$) lower digestibility coefficient of ash in both species.

The data of digestibility of different nutrient groups indicated that animals of group II showed lower digestibility than group I. Processing of feed ingredients to make sani had (Group III) improved the digestibility of the different nutrients.

Economics of milk production

The total cost of experimental feed was calculated considering the existing market rates of different feed ingredients used in the ration (Table 10). Average cost economics (Rs/kg) of dairy animals was presented in table 11.

The total cost of feed (Rs./qt) for wheat straw and concentrate fed to group I was Rs 673.00, while paddy straw and concentrate fed to group II and III were Rs 596.00, Rs 551.17, respectively. Hence, the total cost of feed fed after processing was 37.03, 41.23 and 55.44 for group I, II and III respectively.

The total cost incured on per kg milk yield was Rs.6.01, 5.81 and 5.51, respectively, for group I, II and III. The persual of data showed that the cost (Rs/kg) milk yield was found significantly ($P<0.05$) lower for group II and III than group I because the roughage used in group II and III was paddy straw which, is cheaper than wheat straw.

Table 11: Economics of milk production

Groups	Cost of feed	Processing cost of feed fed/d	Total cost of feed fed (d/Dm)	Cost per kg milk production
I	34.29	2.74	37.03	6.10[b]
II	39.18	2.05	41.23	5.81[a]
III	49.40	6.04	55.44	5.51[a]

Means bearing different superscripts in a column differ significantly $p<0.05$.

Discussion

DISCUSSION

Proximate composition of experimental feeds

Crude protein of concentrate mixture and complete feed (sani) were estimated as 15.66 and 13.30 per cent, respectively. Other contents of sani were 3.95, 23.41, 46.31 and 13.08 per cent respectively for EE, CF, NFE and ash. The values obtained from proximate composition of experimental feeds are in close agreements with Reddy *et al.*, (1994), Owen (1979) and Reddy *et al.*, (1996). The crude fibre value of paddy straw is more or less similar to the values of Pal *et al.* (1999) and Das and Ghosh (2001).

Roughage concentrate ratio

The roughage and concentrate ratio of group I and II were 45:55 while the ratio of roughage concentrate in feed group III, comprising of sani was 40 and 60 indicating that ratio of roughage and concentrate in all the three groups are more or less similar. There was no significant ($P<0.05$) difference among treatment groups. Earlier workers like Coppock *et al.* (1994), Senger *et al.* (1999) and Tiwari *et al.* (1995) have also opined that ratio of 45:55 between roughage and concentrate was found satisfactory for feeding of dairy animals.

Daily feed and dry matter intake

The average daily feed intake (kg/head) was significantly ($P<0.05$) higher in sani Group III (16.72), than that of group I (14.74). Which was a little higher than those of group II (14.52). The present findings are in close agreement with findings of Agnew (1996) and Waje (1996). The

daily feed intake: (kg/head) in cows and buffaloes was significantly ($P<0.01$) higher in complete feed sani(group III)than that of group I and II. Observations on feed intake in the on present study are similar to that of Das and Kundu (1995), Puri and Gupta (1990) and Misra (1995).

The possible reason for significantly ($P<0.05$) higher dry matter intake in complete feed sani group might be due to increased palatability of feed as a result of processing and blending of concentrate with poor quality roughage (Paddy straw) into sani form and impact of physiological activity i.e increase appetite, turnover and enzyme secretion (Yadav *et al.*, 1990, and Verma *et al* 1996) and it has been reported by other workers like Hyunsheok *et al.* (1996), Jawale (1996) and Pachauri (1998) who also studied the effect of feeding complete feed over conventional system of feeding. Contrary to this, the dry mater intakes of buffaloes in group III was significantly ($P<0.05$) lower than group I and II. Finding in buffaloes DM intake were supported by Reddy *et al* (1994), Patle et al. (1992), Singhal *et al.* (1992). The lower dry matter intake may be contributed due to rapid rate of passage of digesta and higher moisture content of sani.

The average daily dry matter intake of buffaloes in group III (11.32) was significantly ($P<0.05$) lower than group I and II (13.41 and 13.21). The average daily dry matter intake in the present study were lesser than reported values (12-13.2kg) by Patle *et al.* (1992) and *Singhal et al.* (1992). The possible reason for lower DMI might be due to variation in moisture content of sani, rapid rate of passage of digesta and variation in season. It is known that higher temperature affects greatly feed intakes in buffaloes. As sani contains more moisture content so the dry matter intakes are reduced, but feed consumption increases

subsequently. Sastry *et al.* (1991) also reported that high temperature caused decline in dry matter intake.

Milk yields and composition

The average daily milk yields (litres) for experimental period of 90 days was 7.40 ± 0.90, 7.50 ± 0.76 and 8.91 ± 0.41 for the cows while it was in buffaloes 5.93 ± 0.59, 8.59 ± 0.86 and 7.39 ± 0.81, respectively, for the group I, II and III. There was no significant difference among the groups but significantly ($P<0.05$) higher milk yield was observed in group III than those of group I and II. The findings are similar to opinion of Nocek *et al.* (1985), Reddy *et al.* (1988) and Muller and Botha (1998).

However, the present investigation is in contrary to the results obtained by Marshal and Voigt (1975), in their study complete feed cause either no significant difference in milk yield or slight increase in milk yield was observed (Reddy *et al* 1996 and Sokolov *et al.* 1985). In other studies significantly ($P<0.05$) higher milk production was obtained by feeding washed paddy straw (washing makes free from oxalates) then blend it with concentrate in the form of sani Pachauri (1998). The impact of dry matter intakes per litre milk production among the treatment groups was close in agreement with Iketaki *et al* (1996). The milk yield values obtained in the present study, were less in group I and II and highest in group III than reported values of Reddy *et al.* (1994). The possible reason of reduction of milk yield of the cows and buffaloes of groups I and II might be due to feeding concentrate and roughage separately which affects the digestibility of nutrients. In the group II animals were fed on chaffed paddy straw as such without washing, as it is well known that paddy straw contains higher oxalates and silica contents. The higher load of oxalates and silica interferes with digestibility of

nutrients. Therefore, poor digestibility of nutrients from paddy straw will leads poor feed consumption which ultimately decreases the daily milk yields of animals.

The results from study indicated that groups III in which animals are feed with complete feed in the form of sani, the digestibility of nutrients increased as well washing of paddy straw, makes it free from oxalates and silica. The higher daily feed intake of sani increases the average daily milk yield.

The per cent value of milk fat, solid not fat (SNF) and total solids (TS) in cows were ranged from 3.74 to 4.60, 8.56 to 8.73 and 12.67 to 12.81 per cent in group I, II and III, respectively, while in buffaloes it ranged from 6 .68 to 6.86, 9.64 to 9.93 and 16.34 to 16.76, respectively.

Fat, SNF and Total solids per cent in the present investigation was higher in milk of cow and buffaloes both but statistically non significant for animals fed on complete feed sani group III than those of group II and conventional group I. The present result is in association with the results reported by earlier workers (Iketaki *et al.* 1996 and Das and Ghosh 2001). The milk fat, SNF and total solids per cents were lower in group fed paddy straw and concentrate separately (Group II), than those of conventional and complete feed sani (Group III). Similar results were indicated by Jawale (1996) and Khan (1999). On the other hand, in other related studies significant variation have been obtained in milk constitutions. Fergurson *et al.* (1990) also reported that feeding of complete feed prepared from oils or cotton seed cake increased percentage of fat significantly although significant effect had not been observed in milk protein.

Digestibility of nutrients

In the present study the dry matter digestibility of cows fed group I, II and III were 54.26, 48.94 and 59.58 per cent, respectively, while in buffaloes it was 58.20, 50.16 and 62.28 per cent respectively, which was in the range indicated by Reddy *et al.* (1996), Jawale (1996), Pachauri (1998).

The digestibility coefficient of dry matter in groups I, II were III differ significantly. Processing and blending of paddy straw and concentrate increased the digestibility of group III and poor dry matter digestibility was shown by cows and buffaloes fed paddy straw and concentrate separate in group II but conventional feeding group I was more DM digestibility coefficient than group II.

Significantly ($P<0.05$) higher digestibility of dry matter on complete feed (Group III) were also reported by Verma *et al.* (1995), Nisal (2000).

The possible reason for higher dry matter digestibility in group III, was due to washing of paddy straw and effective utilization of complete feed sani by rumen micro-organisms (Reddy *et al.*, 1988). Present study also indicates similar observation.

Besides increase in digestibility of dry matter, digestibility coefficient of crude protein was significantly ($P<0.05$) higher on group III followed by group I and II in cows while similar findings was also in buffaloes. The values of CP digestibility on complete feed was in the range as suggested by Reddy *et al* (1996), Satyanarayana Reddy (1992), and Sohane *et al.* (1999).

Significantly (P<.0.05) higher CP digestibility by cow and buffaloes fed complete feed sani (Group III) in the present studies may be attributed to washing of paddy straw and blending effects. (Jawale, 1996, Puri and Gupta, 1990, Khandaker and Tareque, 1999).

The ether extract digestibility of cows fed group I, II and III was 62.49, 44.33 and 63.49 percent, respectively, while in buffaloes it was 67.47, 48.32 and 67.24 percent. Nearly similar to EE digestibility was reported by Srirammurthy *et al.* (1992), Patle *et al.* (1992).

Significantly (P<0.05) higher EE digestibility observed on complete feed sani might be due to effect of processing and blending the grains with soaked paddy straw. This conforin the report of Waje (1996) and Yadav and Yadav (1989).

The crude fibre digestibility was significantly (P<0.05) higher on complete feed sani (group III) fed buffaloes and cows than that of group I and II.

Nearly similar CF digestibility was reported by Kaur and Kaushal (2001) and Das (2002), From the present study it is opined that buffaloes are superior in crude fibre utilization than the cows.

The nitrogen free extract and ash digestibility for the cows and buffaloes fed on group I, II and III was showing significantly, P<0.05) higher on complete feed sani (Group III) than group I and II. Higher NFE and ash digestibility on complete feed was in accordance with Dahiya *et al.* (1998), Chaturvedi and Tiwari (1997). and Yadav *et al.* (2001).

Economics of milk production

The ultimate goal of modern dairy farm is to increase productivity per unit cost. So emphasis was given to calculate the cost of feeding and cost of milk production per litre.

Based on the calculated results, the total cost of feed (Rs/qt) on DM basis for group I, II and III was 673.00, 596.00 and 551.17, respectively. The cost of processing of feed (Rs/qt) was 37.03, 41.23 and 55.44 for group I, II and III respectively. The high cost of processing in present studies was due to increase in process of raw material. (Patle *et al.*, 1990) Panse *et al.* (1991) and Mittal (1990).

The persual of data showed that the cost Rs/ litre milk production was significantly ($P<0.05$) lower for group III (5.51) and II (5.81) than the group I (6.10). This might be due to the roughage used paddy straw, in group II and III is cheaper and economical than that of wheat straw. It is due to higher milk production in group III compared to other groups, which resulted to have less value of feed cost and cost of milk production per litre of milk and high value of daily net income than the rest of other groups, which attributes for significant difference. The present investigation is close agreement with Kalita *et al.* (1998), Singh *et al.* (1998) and Mc Cullough (1994).

Summary

SUMMARY

The 'sani' system followed by the dairies suffers from the imbalance of nutrients, as they do not care to supply the essential nutrients such as calcium, phosphorous, vitamins and protein. It is, therefore, necessary to balance 'sani' system in respect of these nutrients. Thus,the present work was undertaken with following objectives:

1. To evaluate the feeding systems of paddy straw and concentrate mixtures separately, and "sani" system of feeding by blending soaked paddy straw and concentrate mixture together for dairy animals under farm conditions.
2. To study the effect of above systems of feeding on production performance of dairy animals.
3. To study the effect of above system on quality and quantity of milk of dairy animals.
4. To know the digestibility coefficient of different feed by digestion trial in animals.
5. To work out the economics of milk production.
6. To develop a economically viable balanced feed prepared out of locally available concentrates and paddy straw as roughage.

To undertake this study, 18 crossbred dairy cows and buffaloes which were freshly calved, were selected considering their parity, milk yield, stage of lactation and body weight. They were maintained at Livestock Farm, J N K V V, Jabalpur for a period of 90 days (from

March 10 to June 7, 2003). The selected animals were divided into three groups having six animals in each. The animals were randomly distributed in each group.

The dietary groups are as follows :

(a) Group - I: The animals were fed normal conventional ration, which is being fed to other milch animals at Livestock Farm, Adhartal, Jabalpur.

(b) Group - II: The animals were fed chaffed paddy straw and concentrate feed separately.

(c) Group - III: The animals were fed in the form of 'sani', which was prepared by chaffed paddy straw soaked in water overnight and blended with concentrate mixture.

All the experimental animals were maintained under uniform managemental conditions. During the experiment, the following observations were recorded:

1. Proximate composition of experimental feed.
2. Daily feed intake
3. Daily milk yield
4. Fortnightly milk composition
5. Digestion trial at 60 days of experiment.
6. Economics of milk production.

Standard procedures were followed for estimation of different milk constituents, digestion trial and dry matter intakes. Data obtained in each parameter were analyzed using Complete Randomized

Block Design as per methodology described by Snedecor and Cochran (1989) and the following findings are obtained.

Daily feed and dry matter intake

The average daily feed intake per buffalo was observed 14.74 ± 2.08, 14.52 ±1.32 and 16.72 ± 0.89 kg for group I,II and III, respectively, whereas daily dry matter intake of these groups were 13.41±0.07, 13.21±0.86 and 11.32±1.04 kg. The average daily dry matter intake (kg) per cow was observed 11.17±1.26, 11.77±1.56 and 12.01±1.03 while in buffalo it was 10.16±0.97, 10.71±1.26 and 9.80±1.12 for group I, II, and III, respectively. The daily feed intake for cows and buffaloes of group I and II were almost more or less similar, but significantly lower ($P<0.05$) than those of group III, but the average daily dry mater intake in cows and buffaloes of treatments I and II were significantly higher ($P<0.05$) than those of group III.

Milk yield and composition

The average daily milk yield (litre) of cows of group I, II and III were observed as 7.38 ± 0.90, 7.80 ± 0.86 and 8 .68 ± 0.41, respectively, while corresponding figures buffaloes of group I, II and III were estimated as 5.90 ± 0.59, 5.95 ± 0.86 and 7.18 ± 0.81, respectively, indicating significantly higher milk yield ($P<0.05$) animals of group III which were fed feed in the form of sani, in cows and buffaloes both.

The average fat percent in milk of the cows of groups I, II and III were estimated as 4.6 ± 0.12, 3.94 ± 0.17 and 3.74 ± 0.59, respectively, while the corresponding values of fat content in buffalo milk were 6.68 ± 0.06, 6.84 ± 0.97 and 6.86 ± 0.04, respectively. The difference being

insignificant in fat content of different groups. The SNF percent in the milk of cows fed group I, II and III were 8.56 ± 0.31, 8.66 ± 0.76 and 8.73 ± 0.97, whereas in the buffaloes milk SNF percent were 9.71 ± 0.08, 9.64 + 0.07 and 9.93 ± 0.57 observed in group I, II and III, respectively. The values did not differ significantly among the treatment groups of cows and buffaloes. The total solid percent in the milk of cows was 12.71 ± 0.03, 12.67 ± 0.03, 12.81 ± 0.40 in group I II and III, respectively. Similarly in buffaloes milk T.S. percent were 16.34 ± 0.67, 16.54 ± 0.17 and 16.76 ± 0.71 in group I, II and III, respectively. There was no significant difference in total solid in milk of cow and buffaloes among the treatment groups.

Digestibility of nutrients

Digestibility of dry matter in the group I, II and III was 54.26 ± 0.36, 48.94 ± 0.76 and 59.58 ± 0.60, respectively, for cows, while dry matter digestibility among buffaloes were 58.20 ± 0.61, 50.16 + 0.64 and 62.28 ± 0.76, respectively. The significant ($P<0.05$) difference were observed among the treatment groups however in group III significantly ($P<0.05$) higher digestibility of dry matter in cows and buffaloes. The digestibility coefficient of crude protein for cow fed on conventional feed, roughage concentrate separate and complete feed sani was 56.75 ± 0.83, 47.95 ± 0.56 and 57.56 ± 0.58, respectively, in cows .while, CP digestibility is buffaloes were 58.90 ± 0.50, 50.55 ± 0.15 and 58.99 ± 0.58, respectively, which was found significantly ($P<0.05$) different among themselves. There was significantly ($P<0.05$) lower CP digestibility, in which roughage concentrate separate feeding practiced. The digestibility coefficient of ether extract for group I, II and III was 62.49 ± 1.0, 44.33 ± 0.90 and 63. 49 ± 0.16, respectively, in cows, while in

buffaloes it was 67.47 ± 0.20, 48.31 ± 1.0 and 67.24 ± 0.35, respectively. All the three groups were found significant (P<0.05) difference among themselves. Group II was showing significantly. (P<0.05) lower EE digestibility coefficient in cows and buffaloes both.

Crude fibre digestibility was 61.17 ± 0.22, 55.38 ± 0.62 and 63.25 ± 0.30, respectively, in cows, whereas in buffaloes 65.73 ± 0.32, 58.49 ± 0.22 and 66.31 ± 0.63, respectively, in group I, II and III. There was significantly (P<0.05) higher crude fibre digestibility was observed in cows and buffaloes of group III.

The nitrogen free extract digestibility in group I, II and III was 54.64 ± 0.67, 53.54 ± 0.13 and 57.86 ± 1.1, respectively, in cows, whereas in buffaloes it was 55.09 ± 1.1, 59.17 ± 1.0 and 61.92 ± 1.7, respectively. All the three groups were significantly (P<0.05) different.

Ash content digestibility for group I, II and III was 30.12 ± 0.84 , 30.25 ± 0.80 and 27.65 ± 0.13, respectively, in cows, whereas in buffaloes ash digestibility was 36.62 ± 0.74 , 35.92 ± 0.82 and 38.44 ± 0.28, respectively. The difference in digestibility coefficient of Ash in group I and III was non significant (P<0.05) but group II show significantly (P<0.05) lower digestibility coefficient of ash in both species.

Cost economics of experimental feed and milk production

The total cost of feed (Rs. /qt) for wheat straw and concentrate fed to group I was Rs 673.00 while paddy straw and concentrate fed to group II was Rs 596.00 and complete feed sani fed to group III was Rs 551.17. Hence, the total cost of feed fed after processing was 37.03, 41.23 and

55:44 for group I, II and III, respectively. The total cost incured on per kg milk yield was Rs.6.01, 5.81 and 5.51, respectively, for group I, II and III.

The persual of data showed that the cost (Rs/kg) milk yield was found significantly ($P<0.05$) lower for group II and III than group I because the roughage used in group II and III was paddy straw which is much cheaper than wheat straw.

Conclusions

CONCLUSIONS

The following conclusions can be drawn from the present study :-

1. There was significantly higher feed intake and dry matter intake in those groups, which were fed complete feed in the form of sani (Group III) than normal conventional diet (groups I) and separate concentrate and paddy straw feeding (groups II) in cows.

2. In the buffaloes significantly higher feed intake was found in group III, where animals fed complete feed in the form of sani.

3. Milk yield was highest in those animals, which were fed 'sani'.

4. There was no significant variation observed among different groups in milk constituents (percentage of fat, SNF and TS).

5. The average roughage concentrate ratio was 40:60 in complete feed.

6. The significantly higher nutrient digestibility coefficient was observed in cows and buffaloes of complete feed group (sani). Poorest digestibility was recorded in the group where untreated paddy straw and concentrate were fed separately.

7. The lowest cost of milk production per litre was calculated in group III, which were fed sani.

Suggestions for Further Work

SUGGESTIONS FOR FURTHER WORK

1. Effect of different processing technology on paddy straw like urea treatment and lime treatment for feeding in dairy animals for a longer period may be undertaken.

2. Different economical balanced feeding strategies involving different poor digestible fodder may be worked out for producing higher milk production.

3. Further study is needed to see the effect of paddy straw based complete feed on growth, production and reproduction performances of dairy animals on long term basis.

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