The Pharma Innovation Journal 2022; SP-11(2): 954-963

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(2): 954-963

www.thepharmajournal.com
Received: 22-12-2021
Accepted: 24-01-2022

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Cooked broken rice as a source of energy instead of maize at a constant nutrient intake in lactating Murrah buffaloes

Bhavna Aharwal, Biswajit Roy, Rahul Sehar, Jyotsana Shakkarpude, GP Lakhani, Aditya Mishra, Chandrapal Solanki and Shraddha Shrivastav

Abstract
The use of cooked rice grain instead of maize in lactating murrah buffaloes diets was investigated. The experiment was performed at Livestock Farm, Adhartal, College of Veterinary Science and Animal Husbandry, NDVSU, Jabalpur (M.P.) The objectives of the experiment was cooked broken rice as a source of energy instead of maize at a constant nutrient intake in lactating murrah buffaloes. A total of 12 peri-parturiant Murrah buffaloes, 5 days post-partum were randomly assigned into two different groups as control (C) and Group-1 (CR) with 6 animals in each group. In group C only basal diet was offered as per individual animals requirement where as in CR group the maize was replaced by cooked broken rice.
The results showed that feeding cooked broken rice instead of maize had no effects (P>0.05) on total DMI, live weight change, nutrient intake but daily milk yield and DMI (%BW) were found significant in different treatment groups. The overall average total feed intakes (kg/animal) were 43.49±0.74 and 41.27±0.83 in control and CR groups, respectively. The overall total dry matter intake (kg/animal) of lactating Murrah buffaloes were 15.87±0.13 and 15.61±0.15 in control and CR groups, respectively. The overall average monthly body weight (kg) of lactating Murrah buffaloes were 536.25±15.49 and 522.23±16.96 in control, and CR groups, respectively. The overall average milk yield was 7.59±0.05 and 8.06±0.05 in control and CR groups, respectively significant (p>0.05) difference was observed over the experimental period.
Blood samples was collected from each buffaloes at monthly interval to know the serum enzymes i.e. ALP, AST, ALT, biochemical analysis includes BUN have no significant (P>0.05) difference were observed on various blood parameters of lactating Murrah buffaloes over the experimental period. The study concluded that maize can be replaced by broken rice in cooked form in lactating murrah buffaloes.

Keywords: broken rice, cooked broken rice, replacement of maize, Murrah buffaloes

1. Introduction
Buffalo has been an integral part of livestock farming for over 5000 years producing draft power, milk, meat and hides. In India, it plays a very important role in the economy of small holders as well as landless farmer India who owned about 67% of dairy animals. The population of buffaloes is estimated to be 109.85 million. During the year 2019-20, total milk production of India is 198.4 million tons as compared from last year, which was 187.7 million tons (Economic Survey, 2021) [25]. Buffaloes contribute 49% and cattle contribute 48% of the total milk production although buffalo population is nearly half to that of cattle (DAHD, 2019) [19].
During early lactation, dairy animals remain in negative energy balance for first 8 to 12 weeks because energy intake is insufficient to meet the energy requirement (Pantoja *et al*., 1996) [74]. The period is characterized by depressed concentrations of glucose, reduced insulin levels, increased hepatic gluconeogenesis, increase in NEFA and BHBA (Drackley, 1999) [27]. During the periparturient period, physiological changes occur within a short period and this period is critical for dairy animals (Grummer, 1993) [36].
There are many cereal grains out of which maize is a major part in the diet. Maize (*Zea mays*) is the most common cereal used for dairy animals worldwide because of its low fiber and high energy content. High production cost of cereal grains emphasis on demand and supply chain (Allen *et al*., 2000) [2]. Rice (*Oryza sativa*) is the main source of carbohydrates for human consumption globally (Miyaji *et al*., 2014) [63].
Broken rice is less demanding and abundantly available throughout India. It is readily available at a very reasonable price (Knegsel *et al*., 2007) [48].

2. Materials and Methods

2.1 Selection and grouping of experimental animals

A total of 12 periparturant Murrah buffaloes were selected for the experiment. All the selected animals were maintained under semi intensive system, apparently healthy and experiment was conducted as per the guidelines of Institutional Animal Ethics Committee (IAEC). A total of eighteen Murrah buffaloes of 5 days post-partum were randomly assigned into two different groups as Control (C) basal diet was offered. In CR group the maize was replaced by cooked broken rice. Diet was formulated according to nutrient requirement of lactating Murrah buffalo as per (ICAR, 2013) [42]. The buffaloes were housed in a well-ventilated shed having cemented floor with individual feeding and watering arrangement. In morning and evening, buffaloes were offered weighed quantity of concentrates at the time of milking followed by roughage (dry + green) feeding. The animals were let loose for about 1-2 hours daily in the adjoining paddock for exercise. Clean fresh water was made available *ad libitum*.

Table 1: The experimental design during the experiment

S No.	Groups	Number of lactating buffaloes	Treatments
1	Control (C)	6	Basal diet
3	Group-2 (CR)	6	In concentrate mixture, maize was replaced by cooked broken rice

2.2. Parameters recorded

All the animals were maintained under semi-intensive system of farming. Experimental animals were included in the study from 5th day postpartum and continued up to 7 months. Broken rice was cooked in an electric cooker at 100^{o}C for 30 minutes using water:dry rice ratio of 2:1 and was left to cool before feeding. Daily milk yield (kg) of the animals was measured in the morning and evening i.e., at the time of milking. The body weight of the animals was recorded at monthly interval in the morning before feeding with the help of electronic weighing balance. The quantity of various feed and fodder consumed by the animals (green fodders, wheat straw and concentrate) was measured and based on the dry matter content of the feed ingredients total dry matter intake was calculated. The intake of green fodders, wheat straw and concentrate were recorded daily by subtracting the amount of left over from the quantity offered. The data was pooled and average on monthly basis. Samples of feed and fodder were collected for analysis of proximate principles *viz.* dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen free extract (NFE) and total ash by the standard methods (AOAC, 2016) [7]. The data were analyzed using one way ANOVA, described by Snedecor and Cochran (2004) [92] using the following model. Means showing significant differences in the ANOVA table were compared using the Duncan Multiple Range Test (Steel and Torrie, 1980) [93].

3. Results and Discussion

3.1 Chemical composition (%) maize, broken rice and cooked rice

The chemical compositions (%) of maize, broken rice and cooked rice are depicted in table 2. The dry matter content (%) was 89.00 and 37.00 in maize and cooked rice, respectively. The crude protein content (%) of the concentrate mixture was 7.48 and 6.70 in maize and cooked rice, respectively. The ether extracts content (%) of the concentrate mixture was 2.89 and 2.87 in maize and cooked rice, respectively. The crude fiber content (%) of the concentrate mixture was 9.50 and 0.00 in maize and cooked rice, respectively. The ash content (%) of the concentrate mixture was 2.10 and 0.83 in maize and cooked rice, respectively. The nitrogen-free extract content (%) of the concentrate mixture was 77.93 and 89.60 in maize and cooked rice, respectively.

Table 2: Chemical composition (%) of maize, broken rice and cooked rice used in the experiment

Compositions	Maize	Cooked broken rice
Dry matter (%)	89.00	37.00
Crude protein (%)	7.48	6.70
Ether extract (%)	2.99	2.87
Crude fiber (%)	9.50	0.00
Ash (%)	2.10	0.83
Nitrogen-free extract (%)	77.93	89.60

3.2 Chemical composition (%) of concentrate mixture

The chemical compositions (%) of concentrate mixture are depicted in table 3. The dry matter content (%) of concentrate mixture was 92.11 and 89.30 in C and CR groups, respectively. The crude protein content (%) of the concentrate mixture was 19.90 and 19.70 in C and CR group, respectively. The ether extracts content (%) of the concentrate mixture was 5.23 and 5.77 in C and CR group, respectively. The ash content (%) of the concentrate mixture was 11.80 and 8.70 in C and CR group, respectively. The crude fiber content (%) of the concentrate mixture was 9.21 and 9.71 in C and CR group, respectively. The nitrogen-free extract (%) content of the concentrate mixture was 55.56 and 57.62 in C and CR group, respectively.

Table 3: Chemical composition (%) of concentrate mixture offered to different experimental groups

Compositions	C	CR
Dry matter (%)	92.11	89.30
Crude protein (%)	19.90	19.70
Ether extract (%)	5.23	5.77
Ash (%)	9.21	8.15
Crude fiber (%)	11.80	8.70
Nitrogen-free extract (%)	55.56	57.68

3.3 Chemical compositions (%) of green fodder and dry fodder

The chemical compositions of green fodder and dry fodder are depicted in table 4. The dry matter content (%) of the green fodder and dry fodders values were 21.00, 23.00, 15.80, 18.21 and 93.00 in napier grass, M.P chari, berseem, mustard fodder and wheat straw, respectively. The crude protein content (%) of green fodder and dry fodders were 10.22, 11.30, 15.50, 19.20 and 0.92 in napier grass, M.P chari, berseem, mustard fodder and wheat straw, respectively. The ether extracts content (%) of green fodder and dry fodders were 3.10, 4.40, 5.20, 8.88 and 1.23 in napier grass, M.P chari, berseem, mustard fodder and wheat straw, respectively. The ash content (%) of the green fodder and dry fodder was 32.00, 33.10, 29.10, 33.00 and 47.80 in napier grass, M.P chari, berseem, mustard fodder and wheat straw, respectively. The crude fiber content (%) of green fodder and dry fodders were 13.20, 10.50, 9.60, 15.10 and 20.22 in napier grass, M.P chari, berseem, mustard fodder and wheat straw, respectively. The nitrogen-free extract content (%) of green fodder and dry

fodders were 41.48, 40.70, 40.60, 23.82 and 29.83 in napier grass, M.P chari, berseem, mustard fodder and wheat straw, respectively.

Table 4: Chemical composition (%) green fodder and dry fodder offered to experimental groups

Compositions	Green fodders				Dry fodder
	Napier grass	M.P chari	Berseem	Mustard fodder	Wheat straw
Dry matter (%)	21.00	23.00	15.80	18.21	93.00
Crude protein (%)	10.22	11.30	15.50	19.20	0.92
Ether extract (%)	3.10	4.40	5.20	8.88	1.23
Ash (%)	13.20	10.50	9.60	15.10	20.22
Crude fibre (%)	32.00	33.10	29.10	33.00	47.80
Nitrogen-free extract (%)	41.48	40.70	40.60	23.82	29.83

3.4 Average total feed intake (kg/animal)

The data presented in table no 5 represents the effect of feeding broken rice instead of maize on average total feed intake (kg/animal) of lactating Murrah buffaloes. In 1st month, average total feed intake (kg/animal) values were 39.58±1.69 and 48.46±0.97 in C and CR groups, respectively. In 2nd month, average total feed intake (kg/animal) values were 46.54±1.73 and 43.18±1.98 in C and CR groups, respectively. In 3rd month, average total feed intake (kg/animal) values were 43.30±2.57 and 41.04±1.89 in C and CR groups, respectively. In 4th month, average total feed intake (kg/animal) values were 47.31±1.41, and 37.31±2.49 in C and CR groups, respectively. In 5th month, average total feed intake (kg/animal) values were 42.98±1.59 and 42.28±2.03 in C and CR groups, respectively. In 6th month, average daily total feed intake (kg/animal) values were 45.87±1.79 and 36.91±2.25in C and CR groups, respectively. In 7th month, average daily total feed intake (kg/animal) values were 39.49±2.07 and 39.05±1.83 in C and CR groups, respectively. The overall average total feed intakes (kg/animal) were 43.49±0.74 and 41.27±0.83 in C, and CR groups, respectively. In present study no significant (P>0.05) difference was observed on month wise average total feed intake (kg/animal) of lactating Murrah buffaloes average the experimental period.

Table 5: Effect of feeding broken rice instead of maize on monthly total feed intake (kg/animal) of lactating Murrah buffaloes in experimental groups

Months	C	CR
1	39.58±1.69	48.46±0.97
2	46.54±1.73	43.18±1.98
3	43.30±2.57	41.04±1.89
4	47.31±1.41	37.31±2.49
5	42.98±1.59	42.28±2.03
6	45.87±1.79	36.91±2.25
7	39.49±2.07	39.05±1.83
Overall	43.49±0.74	41.27±0.83

3.5 Total daily dry matter intake (kg/animal)

The data presented in table no 6 represents the effect of feeding broken rice instead of maize on total dry matter intake (kg/animal) of lactating Murrah buffaloes. In 1st month, total dry matter intake (kg/animal) values were 15.53±0.27 and 16.45±0.2 in C and CR groups, respectively. In 2nd month, total dry matter intake (kg/animal) values were 16.64±0.30 and 15.61±0.37 in C and CR groups, respectively. In 3rd month, total dry matter intake (kg/animal) values were 15.45±0.46 and 15.88±0.39 in C and CR groups, respectively. In 4th month, total dry matter intake (kg/animal) values were 16.42±0.34 and 15.15±0.59 in C and CR groups, respectively. In 5th month, total protein intake (kg/animal) values were 15.50±0.30 and 15.94±0.36 in C and CR groups, respectively. In 6th month, total dry matter intake (kg/animal) values were 15.94±0.34 and 14.94±0.40 in C and CR groups, respectively. In 7th month, total dry matter intake (kg/animal) values were 15.67±0.33 and 15.23±0.43 in C and CR groups, respectively. The overall total dry matter intake (kg/animal) of lactating Murrah buffaloes were 15.87±0.13 and 15.61±0.15 in C and CR groups, respectively. In present study no significant (P>0.05) difference was observed on total dry matter intake (kg/animal) of lactating Murrah buffaloes among the experimental period.

Table 6: Effect of feeding broken rice instead of maize on month wise total daily dry matter intake (kg/animal) of lactating Murrah buffaloes in experimental groups

Months	C	CR
1	15.53±0.27	16.45±0.2
2	16.64±0.30	15.61±0.37
3	15.45±0.46	15.88±0.39
4	16.42±0.34	15.15±0.59
5	15.50±0.30	15.94±0.36
6	15.94±0.34	14.94±0.40
7	15.67±0.33	15.23±0.43
Overall	15.87±0.13	15.61±0.15

3.6 Average daily dry matter intake (%BW)

The data presented in table no 7 represents the effect of feeding broken rice instead of maize on average dry matter intake (% body weight) of lactating Murrah buffaloes. In 1st month, the dry matter intake (% body weight) values were 3.06±0.08 and 3.36±0.09 in C and CR groups, respectively. In 2nd month, the dry matter intake (% body weight) values were 2.91±0.11 and 3.49±0.14 in C and CR groups, respectively. In 3rd month, the dry matter intake (% body weight) values were 2.87±0.08 and 3.27±0.06 in C and CR groups, respectively. In 4th month, the dry matter intake (% body weight) values were 3.05±0.09 and 3.09±0.09 in C, and CR groups, respectively. In 5th month, the dry matter intake (% body weight) values were 2.91±0.06 and 3.18±0.08 in C and CR groups, respectively. In 6th month, the dry matter intake (% body weight) values were 2.91±0.04 and 3.04±0.07 in C and CR groups, respectively. In 7th month, the dry matter intake (% body weight) values were 2.76±0.05 and 2.89±0.16 in C, and CR groups, respectively. The overall average dry matter intake (% body weight) of lactating Murrah buffaloes were 2.91±0.03 and 3.17±0.04 in C and CR groups, respectively. In present study significant (P>0.05) difference was observed on average dry matter intake (% body weight) of lactating Murrah buffaloes among the experimental period.

Table 7: Effect of feeding broken rice instead of maize on month wise average daily dry matter intake (%BW) of lactating Murrah buffaloes in experimental groups

Months	C	CR
1	3.06±0.08	3.36±0.09
2	2.91±0.11	3.49±0.14
3	2.87±0.08	3.27±0.06
4	3.05±0.09	3.09±0.09
5	2.91±0.06	3.18±0.08
6	2.91±0.04	3.04±0.07
7	2.76±0.05	2.89±0.16
Overall	2.91[a]±0.03	3.17[b]±0.04

[a] & [b] means bearing different superscripts in the same row differ significantly (P<0.05)

3.7 Average dry matter intake (g/kg $W^{0.75}$)

The data presented in table no 8 represents the effect of feeding broken rice instead of maize on average dry matter intake (g/kg $W^{0.75}$) of lactating Murrah buffaloes. In 1st month, the dry matter intake (g/kg $W^{0.75}$) values were 0.144±0.004 and 0.123±0.001 in C, and CR groups, respectively. In 2nd month, the dry matter intake (g/kg $W^{0.75}$) values were 0.137±0.004 and 0.134±0.003 in C and CR groups, respectively. In 3rd month, the dry matter intake (g/kg $W^{0.75}$) values were 0.134±0.003, and 0.142±0.004 in C and CR groups, respectively. In 4th month, the dry matter intake (g/kg $W^{0.75}$) values were 0.141±0.003 and 0.139±0.003 in C and CR groups, respectively. In 5th month, the dry matter intake (g/kg $W^{0.75}$) values were 0.141±0.002 and 0.141±0.003 in C and CR groups, respectively. In 6th month, the dry matter intake (g/kg $W^{0.75}$) values were 0.141±0.002, and 0.137±0.002 in C and CR groups, respectively. In 7th month, the dry matter intake (g/kg $W^{0.75}$) values were 0.135±0.001 and 0.134±0.002 in C and CR groups, respectively. The overall average dry matter intake (g/kg $W^{0.75}$) 0.139±0.001 and 0.142±0.002 in C and CR groups, respectively. In present study, no significant (P>0.05) difference was observed on average dry matter intake (g/kg $W^{0.75}$) of lactating Murrah buffaloes among the experimental period.

Table 8: Effect of feeding broken rice instead of maize on dry matter intake (g/kg $W^{0.75}$) of lactating Murrah buffaloes in experimental groups

Months	C	CR
1	0.144±0.004	0.123±0.001
2	0.137±0.004	0.134±0.003
3	0.134±0.003	0.142±0.004
4	0.141±0.003	0.139±0.003
5	0.141±0.002	0.141±0.003
6	0.141±0.002	0.137±0.002
7	0.135±0.001	0.134±0.002
Overall	0.139±0.001	0.142±0.002

The finding of the present study was supported by Shingfield *et al*. (2011) [86] who reported no effect of whole grains supplementation in a corn silage-based diet of growing steers on dry matter intake. Benchaar *et al*. (2012) [11] revealed that corn silage-based diet supplementation at 2%, 3% or 4% dry matter to lactating dairy cows fed with corn replacement in a total mixed ration with a R:C ratio of 50:50 had no effect on dry matter intake. Lunsin *et al*. (2012) [56] did not find any significant differences of dry matter intake in animals fed 4% rice with rice bran oil in the concentrate mixture. Dhiman *et al*. (2000) [21] also reported no negative influence on feed intake when supplementing broken rice, sorghum instead of maize or rice bran oil. In another study (Zhong *et al*., 2008), barley grain used as replacement of corn in the diet of experimental animals and resulted in non significant change of DMI.

In contrast to the above findings, Krause *et al*. (2002) [51] reported decreased in DMI when cows were fed more rapidly available starch sources. Similarly, Oba and Allen (2003) [72] reported depression of DMI in cows fed especially high starch diets. However, Khorasani *et al*. (2001) [47] and Krause *et al*. (2003) [52] reported greater ruminal starch digestibility did not decrease DMI when processed grains replaced in the total mixed ration. Miyaji *et al*. (2015) [66] and Silveria *et al*. (2007) [87] also reported that increase level of ruminally fermentable starch did not affect DMI when refined corn starch replaced starch from dry cracked corn up to 57.0% of the total dietary starch, despite high dietary starch conditions (29.2-32.8%) but makes the rapid energy available in the animal body.

In various studies researchers reported that dietary starch content has a large impact on DMI (Gencoglu *et al*., 2010 and Ferraretto *et al*., 2011) [31, 30]. DMI was greater for cows fed a reduced-starch diet compared with those fed a normal starch diet (Svihus *et al*., 2005) [94]. Although the ruminal digestibility of starch was greater compared with that of grind, the increased starch loss due to the ensiling process with steam flaked grains could have reduced the adverse effect of high starch degradation, and thus inhibited the decrease of DMI (Miyaji *et al*., 2010) [67].

Enishi *et al*. (2000) [26] and Miyaji *et al*. (2010) [67] compared ruminal digestion characteristics of rice with those of oat, wheat and corn grain. Ruminal starch digestibility would increase linearly by increasing the levels of broken rice in total mixed ration silage in cows. They concluded that *in situ* the rice starch was digested more rapidly than the corn grain starch in.

Although the rice starch was digested more rapidly than the corn grain starch, the starch content in the diets was not high in comparison to the total carbohydrate available in the diet. Thus, the low dietary starch condition might explain why DMI depression was not detected following the replacement of maize with broken rice (Miyaji *et al*., 2016) [62].

3.9 Body weight (kg)

The data presented in table no 10 represents the effect of feeding broken rice instead of maize on monthly body weight (kg) of lactating Murrah buffaloes. In 1st month, the body weight (kg) values were 513.75±19.81 and 461.11±20.16 in C and CR groups, respectively. In 2nd month, the body weight (kg) values were 550.21±22.75 and 492.56±28.89 in C and CR groups, respectively. In 3rd month, the body weight (kg) values were 562.50±13.85 and 522.22±17.54 in C and CR groups, respectively. In 4th month, the body weight (kg) values were 525.32±14.51 and 536.25±15.91 in C and CR groups, respectively. In 5th month, the body weight (kg) values were 524.44±10.15 and 522.55±13.72 in C and CR groups, respectively. In 6th month, the body weight (kg) values were 525.83±11.91 and 543.33±19.84 in C and CR groups, respectively. In 7th month, the body weight (kg) values were 552.72±16.47 and 558.45±10.19 in C and CR groups, respectively. The overall average monthly body weight (kg) of lactating Murrah buffaloes were 536.25±15.49 and 522.23±16.96 in C and CR groups, respectively. In present study no significant (P>0.05) difference was observed on monthly body weight (kg) of lactating Murrah buffaloes among the experimental period.

Table 10: Effect of feeding broken rice instead of maize on month wise body weight (kg) of lactating Murrah buffaloes in experimental groups

Months	C	CR
1	513.75±19.81	461.11±20.16
2	550.21±22.75	492.56±28.89
3	562.50±13.85	522.22±17.54
4	525.32±14.51	536.25±15.91
5	524.44±10.15	522.55±13.72
6	525.83±11.91	543.33±19.84
7	552.72±16.47	558.45±10.19
Overall	536.25±15.49	522.23±16.96

In the present study, there were neither significant changes of body weight observed across the groups. The buffaloes available at Livestock farm, College of Veterinary Science and AH, Jabalpur at the time experiment were included in the study. All the buffaloes were medium yielder. Thus, not much body weight loss was observed in both the groups. The findings of the present study were in agreement with Miyaji *et al*. (2012) [64], who fed lactating cows with steam-flaked brown rice in place of steam-flaked corn, reported that body weight changes were not significant among the three treatment groups. Nikkhah *et al*. (2004) [70] stated that the grind barley and ground sorghum did not affect live body weight changes of the experimental animals over the course of the feeding trial.

3.10 Average daily milk yield (kg/animal)

The data presented in table no 11 represents the effect of feeding broken rice instead of maize on fortnightly average daily milk yield (kg/animal) of lactating Murrah buffaloes. In 1st fortnight, milk yield (kg/animal) values were 7.26±0.23 and 7.35±0.19 in C, and CR groups, respectively. In 2nd fortnight, average daily milk yield (kg/animal) values were 8.92±0.19 and 8.89±0.18 in C and CR groups, respectively. In 3rd fortnight, average daily milk yield (kg/animal) values were 8.7±0.16 and 9.39±0.17 in C and CR groups, respectively. In 4th fortnight, average daily milk yield (kg/animal) values were 8.47±0.18 and 9.22±0.18 in C and CR groups, respectively. In 5th fortnight, average daily milk yield (kg/animal) values were 8.35±0.16 and 8.76±0.17 in C and CR groups, respectively. In 6th fortnight, average daily milk yield (kg/animal) values were 7.78±0.17 and 8.69±0.13 in C and CR groups, respectively. In 7th fortnight, average daily milk yield (kg/animal) values were 7.83±0.16 and 8.33±0.15 in C and CR groups, respectively. In 8th fortnight, average daily milk yield (kg/animal) values were 7.61±0.17 and 8.29±0.14 in C and CR groups, respectively. In 9th fortnight, average daily milk yield (kg/animal) values were 7.40±0.16 and 7.73±0.12 in C and CR groups, respectively. In 10th fortnight, average daily milk yield (kg/animal) values were 7.15±0.15, and 7.62±0.11 in C and CR groups, respectively. In 11th fortnight, average daily milk yield (kg/animal) values were 7.11±0.17 and 7.16±0.13 in C and CR groups, respectively. In 12th fortnight, average daily milk yield (kg/animal) values were 6.76±0.13 and 6.92±0.16 in C and CR groups, respectively. In 13th fortnight, average daily milk yield (kg/animal) values were 6.37±0.13 and 6.83±0.16 in C and CR groups, respectively. In 14th fortnight, average daily milk yield (kg/animal) values were 5.84±0.29 and 6.78±0.38 in C and CR groups, respectively. The overall average daily milk yield of lactating Murrah buffaloes were 7.59±0.05 and 8.06±0.05 in C and CR groups, respectively. In present study significant (P>0.05) difference was observed on fortnightly average daily milk yield (kg/animal) of lactating Murrah buffaloes among the experimental period.

Table 11: Effect of feeding broken rice instead of maize on fortnightly average daily milk yield (kg/animal) of lactating Murrah buffaloes in experimental groups**.**

Fortnights	C	CR
1	7.26±0.23	7.35±0.19
2	8.92±0.19	8.89±0.18
3	8.70±0.16	9.39±0.17
4	8.47±0.18	9.22±0.18
5	8.35±0.16	8.76±0.17
6	7.78±0.17	8.69±0.13
7	7.83±0.16	8.33±0.15
8	7.61±0.17	8.29±0.14
9	7.40±0.16	7.73±0.12
10	7.15±0.15	7.62±0.11
11	7.11±0.17	7.16±0.13
12	6.76±0.13	6.92±0.16
13	6.37±0.13	6.83±0.16
14	5.84±0.29	6.78±0.38
Overall	7.59^{a}±0.05	8.06^{b}±0.05

a&b Means bearing different superscripts in the same row differ significantly (P<0.05).

The daily milk yield of experimental Murrah buffaloes were recorded (morning and evening), the data were presented on the fortnightly basis. In present, study there was significant difference (P>0.05) in milk yield among the groups. Average daily milk yield was highest in CR group and the value was significantly higher than other two groups, i.e., C and BR. Similar findings were reported by various researchers (Joy *et al*., 1997; Oliveira *et al.*, 1993 and Kalscheur *et al*., 1997) [44, 73, 46]. Feeding steam-processed grain resulted in higher availability of starch which ultimately provides more VFA, particularly propionic acid and also the microbial mass required by high-producing cows and it also improved nutrient uptake by the mammary gland. Synchronization of nutrient supply as per requirements leads to higher milk production (Oliveira *et al.*, 1993 and Kalscheur *et al*., 1997) [73, 46].

3.11 Blood Urea Nitrogen (mg/dl)

The data presented in table no 12 represents the effect of feeding broken rice instead of maize on blood urea nitrogen (mg/dl) in lactating Murrah buffaloes. In group C, values were 18.87±0.23, 16.47±1.64, 19.76±1.65 and 19.17±1.64 in initial, 2nd, 4th and 6th months, respectively. In CR group, values of blood urea nitrogen (mg/dl) were 19.65±0.31, 16.30±1.50, 19.59±1.50 and 19.00±1.50 in initial, 2nd, 4th and 6th months, respectively. The overall blood urea nitrogen (mg/dl) in lactating Murrah buffaloes were 18.57±0.72 and 18.63±0.67 in C and CR groups, respectively. In present study no significant (P>0.05) difference was observed on blood urea nitrogen (mg/dl) of lactating Murrah buffaloes among the experimental period.

Table 12: Effect of feeding broken rice instead of maize on blood urea nitrogen (mg/dl) of lactating Murrah buffaloes

Months	C	CR
Initial	18.87±0.23	19.65±0.31
2nd	16.47±1.64	16.30±1.50
4th	19.76±1.65	19.59±1.51
6th	19.17±1.64	19.00±1.50
Overall	18.57±0.72	18.63±0.67

3.12 Serum alkaline phosphatase (U/L)

The data presented in table no 13 represents the effect of feeding broken rice instead of maize on serum alkaline phosphatase (U/L) in lactating Murrah buffaloes. In group C, values were 223.62±15.44, 233.59±15.43, 247.84±15.44 and 237.48±15.45 in initial, 2nd, 4th and 6th months, respectively. In CR group values of serum alkaline phosphatase (U/L) were 140.4±19.97, 150.37±19.96, 164.62±19.95 and 154.26±19.97 in initial, 2nd, 4th and 6th months, respectively. The overall serum alkaline phosphatase (U/L) in lactating Murrah buffaloes were 235.63±17.42 and 152.42±19.49 in C and CR groups, respectively. In present study no significant (P>0.05) difference was observed on serum alkaline phosphatase (U/L) of lactating Murrah buffaloes among the experimental period.

Table 13: Effect of feeding broken rice instead of maize on serum alkaline phosphatase (U/L) of lactating Murrah buffaloes

Months	C	CR
Initial	223.62±15.44	140.4±19.97
2nd	233.59±15.43	150.37±19.96
4th	247.84±15.44	164.62±19.97
6th	237.48±15.45	154.26±19.95
Overall	235.63±17.42	152.42±19.49

3.13 Serum aspartate aminotransferase (U/L)

The data presented in table no 14 represents the effect of feeding broken rice instead of maize on serum aspartate aminotransferase (U/L) in lactating Murrah buffaloes. In group C, values were 71.78±3.47, 74.68±3.45, 75.67±3.47 and 78.99±3.46 in initial, 2nd, 4th and 6th months, respectively. In CR group, values of serum aspartate aminotransferase (U/L) were 78.24±1.56, 81.14±1.55, 82.13±1.56 and 85.45±1.55 in initial, 2nd, 4th and 6th months, respectively. The overall serum aspartate aminotransferase U/L in lactating Murrah buffaloes were 75.28±1.70 and 81.74±0.90 in C and CR groups, respectively. In present study no significant (P>0.05) difference was observed on serum aspartate aminotransferase (U/L) of lactating Murrah buffaloes among the experimental period.

Table 14: Effect of feeding broken rice instead of maize on serum aspartate aminotransferase (U/L) of lactating Murrah buffaloes

Months	C	CR
Initial	71.78±3.47	78.24±1.56
2nd	74.68±3.45	81.14±1.55
4th	75.67±3.47	82.13±1.56
6th	78.99±3.46	85.45±1.55
Overall	75.28±1.70	81.74±0.90

3.14 Serum alanine aminotransferas (U/L)

The data presented in table no 15 represents the effect of feeding broken rice instead of maize on serum alanine aminotransferase (U/L) in lactating Murrah buffaloes. In group C, values were 41.12±3.14, 43.73±3.16, 45.67±3.15 and 38.53±2.47 in initial, 2nd, 4th and 6th months, respectively. In CR group, values of serum alanine aminotransferase (U/L) were 40.70±5.05, 43.31±5.06, 45.24±5.05 and 43.99±4.10 in initial, 2nd, 4th and 6th months, respectively. The overall serum alanine aminotransferase (U/L) in lactating Murrah buffaloes were 42.26±1.50 and 43.31±2.28 in C and CR groups, respectively. In present study no significant (P>0.05) difference was observed on serum alanine aminotransferase (U/L) of lactating Murrah buffaloes among the experimental period.

Table 15: Effect of feeding broken rice instead of maize on serum alanine aminotransferase (U/L) of lactating Murrah buffaloes

Months	C	CR
Initial	41.12±3.14	40.70±5.05
2nd	43.73±3.16	43.31±5.06
4th	45.67±3.15	45.24±5.05
6th	38.53±2.47	43.99±4.10
Overall	42.26±1.50	43.31±2.28

Study of blood parameters indicates the overall health and metabolic status of the individual animals. In the present study various blood biochemical parameters were studied to identify any kind of variations and the values were within the normal biological range (Abd Ellah *et al*., 2014) [1]. The levels of the serum activities of alkaline phosphatase (ALP), asparate amino-transferase (AST) and alanine amino-transferase (ALT) and BUN (mg/dL) in the present experiment no significant difference (P>0.05) were found. The serum enzymes were similar and within the normal range in all the groups, changes in enzymes activities may be related to reduce dry matter intake around parturition which might have led to hepatic lipidosis to alter the normal function of the liver (Greenfield *et al*., 2000) [35].

4. Conclusion

Replacement of maize with broken rice (cooked) in concentrate mixture offered to early lactating Murrah buffaloes did not have any impact on dry matter intake (DMI), body weight changes. However, there was significant increase of daily milk yield in the group offered cooked broken rice. Cooked rice in concentrate mixture had no impact on blood biochemical and hematological parameters. The overall finding of the experiment was to find out the alternative source of maize at a constant energy level as cooked rice was replaced in the same amount of maize and the impact was acceptable in this research

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