RESEARCH ARTICLE

Effect of Solid State Fermentation (SSF) Biomass Supplementation on Nutrient Intake, Growth Performance and Cost of Feeding in Crossbred Heifers

Fenil N. Chaudhari[1]*, Makbul A. Shekh[2], Hitesh H. Chaudhari[3], Vijay B. Darji[4]

Abstract

This study was aimed to evaluate the effect of solid state fermentation (SSF) biomass supplementation (@ 3%) on nutrient intake, growth performance and cost of feeding in crossbred heifers. Fifteen crossbred heifers were randomly divided into three groups each of five animals based on body weight, and were individually fed for 98 days. The heifers were fed jawar hay and wheat straw based total mixed ration (TMR) without SSF (T_1, control), TMR with 3% SSF biomass (T_2) and TMR having 10% reduction in protein and energy with 3% SSF biomass (T_3). The results showed that the average dry matter intake (DMI) remained similar among the groups. However, the average crude protein intake (CPI) and total digestible nutrient intake (TDNI) differed significantly in T_1 and T_2 groups as compared to T_3. The average daily body weight gain was significantly increased ($p<0.05$) in SSF fed group T_2 than control group. The feed cost in terms of Rs./kg b. wt. gain was significantly ($p<0.05$) lower in T_2 group as compared to control T_1 group.

Key words: Feed cost, Growth performance, Heifers, Nutrient intake, SSF biomass.

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Introduction

Solid state fermentation (SSF) is the fermentation process where microorganisms are grown in an environment without free water, or with very low content of free water on solid substrate and complex material is converted into simpler form, moreover this solid substratum itself acts as carbon/ energy source (Murthy *et al*., 2018). SSF encouraged the growth of micro-organisms in nature on moist solids and has been created to be blameable for the beginning of fermentation technique in earliest time. It provides various scope in processing of agro industrial residues (Pandey, 2003).

SSF holds remarkable potential for the production of enzyme by microbial flora. It is of special interest as this process includes crude fermented product that can be used directly as enzyme source. Preferably, almost all well-known microbial enzymes can be produced under SSF system. A huge amount of microorganisms, including bacteria, yeast and fungi yield different groups of enzymes, but fungi are the furthermost suitable organism (Doelle *et al*., 1992). The SSF can be a promising tool to improve the growth performance by improving the digestibility of nutrients. Hence, an attempt was made to study the effect of solid state fermentation (SSF) biomass on the nutrient intake, growth performance and cost of feeding in crossbred heifers.

[1-3]Animal Nutrition Research Department, College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand-388110, Gujarat, India

[4]Department of Statistics, BA College of Agriculture, Anand Agricultural University, Anand-388110, Gujarat, India

Corresponding Author: Fenil N. Chaudhari; Animal Nutrition Research Department, College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand-388110, Gujarat, India, E-mail: fenilchaudhari7@gmail.com

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Materials and Methods

Animals, Feeding, Management and Dietary Treatments

The present study was conducted at Animal Nutrition Research Station, College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand, Gujarat

during the year 2019 for the period of 98 days. The permission for animal experiment was granted by Institutional Animal Ethics Committee (IAEC 2019/ANRS/296). Fifteen crossbred heifers of the station were randomly divided into three equal groups each of five heads, based on body weight. All the experimental heifers were fed on TMR in mash form with or without SSF to meet their nutrients needs as per ICAR (2013) standards. The experimental heifers were housed in sheds with proper ventilation, flooring and tying arrangements. Individual feeding of all the heifers was followed.

The crossbred heifers in control group (T_1) were fed total mixed ration containing 50 % jowar hay without SSF biomass, while in group T_2 animals were fed TMR containing jowar hay 50% plus 3 % SSF biomass, whereas, animals in group T_3 were fed TMR containing 25% each jowar hay and wheat straw (with 10% reduction in protein and energy) plus 3% SSF biomass. The SSF on jowar hay was prepared by Department of Microbiology, Gujarat Vidhyapith, Sadra, Ahmedabad with a culture of *Aspergillus spp.,* having activity of various enzymes, *i.e*. carboxy methyl cellulase (CMCase) (124 U/g), filter paperase (FPase) (27.85 U/g), xylanase (306 U/g), laccase (377 U/g), manganese peroxidase (MnP) (330 U/g) and lignin peroxidase (LiP) (307 U/g) assessed by using enzymatic assay technique. The experimental heifers were let loose daily for exercise (except during the period of digestion trial) in an open paddock, for two hours in the morning and one hour in the afternoon under controlled conditions, during which they had free access to fresh, wholesome drinking water. The samples of TMR offered, leftover and faeces were analyzed for proximate principles as per AOAC (1995) and for fibre fractions as per Van Soest *et al*. (1991). The ingredients and chemical composition of TMRs and SSF used are given in Table 1. A 10% reduction in CP and energy in T3 was achieved by reducing the quantity of jowar hay, soybean mean and maize in the TMR (Table 1). Most of the proximate principles (except EE, and phosphorus) were relatively lower and total ash was higher in T_3 than in T_2 and T_1 TMR. The slightly elevated total ash content in treatment T3 could be attributed to the inclusion of 25% wheat straw in it.

Table 1: Ingredient and chemical composition (%) of total mixed rations (TMRs) offered to crossbred heifers

Feed ingredient	Treatment groups		
	T_1	T_2	T_3
Jowar hay	50	50	25
Wheat straw	0	0	25
Soybean meal	10	10	8.5
Maize	12.5	12.5	3.0
DORB	15.5	15.5	28.5
Molasses	10	10	8
Mineral mixture	1	1	1
Common salt	1	1	1
Chemical composition (% on DM basis)			**SSF**
Crude protein	13.66	13.66	12.04	7.74
Ether extract	1.35	1.35	1.35	3.09
Crude fibre	29.41	29.41	27.95	35.79
Nitrogen-free extract	47.08	47.08	45.82	41.83
Total ash	8.50	8.50	12.85	11.55
Organic matter	91.50	91.50	87.15	88.45
Neutral detergent fibre	66.97	66.97	63.92	67.74
Acid detergent fibre	30.40	30.40	29.52	40.60
Calcium	2.85	2.85	2.75	0.71
Phosphorus	0.09	0.09	0.09	0.15

Growth Performance and Cost of Feeding

The daily feed intake was recorded for each experimental heifer during 98 days of experimental period. The experimental heifers were weighed at biweekly intervals in the morning (8.00 a.m.), before feeding and watering during the entire experimental period using electronic weighing balance. The cost of feeding for experimental heifers was calculated from the records of daily feed consumption and by considering the procurement price of feeds, fodder and SSF biomass used for feeding of experimental heifers.

The data generated was subjected to one way analysis of variance (ANOVA) using completely randomized design as per the method of Snedecor and Cochran (1994), with the help of SPSS and WASP software.

Results and Discussion

Nutrient Intake

The effect of feeding SSF biomass on nutrient intake in heifers is presented in Table 2. The average DMI of heifers was numerically high in T_2, but statistically similar among the groups. Thus, feeding of SSF based TMR had no adverse effect on DMI. However, CPI, DCPI and TDNI were significantly lower in T_3 as compared to T_2 and T_1 groups, the highest values were recorded in T_2 group (Table 2). Similar findings were also illustrated by El-Kady *et al*. (2006), who fed enzymatic mixture with cellulase, xylanase, alpha-amylase and polyglacturenase in TMR to male buffalo calves. Further comparable results were also reported earlier by several workers (Titi and Tabbaa, 2004; Singh and Das, 2009; Shekhar *et al*., 2010; Thakur *et al*., 2010; Sherasia (2016), who added different levels of enzymes to the TMR.

Growth Performance

Statistical analysis for the effect of feeding SSF biomass on growth performance (Table 2) revealed significantly higher ($P<0.05$) average daily gain (kg) in b.wt. (kg) in T_2 (0.746 ± 0.07) group as compared to T_1 (0.666 ± 0.05) and T_3 (0.655 ± 0.09), where T_1 & T_3 treatments were at par with each other, which indicates that reduction of 10% of CP and TDN

in T_3 group with 3% SSF biomass did not affect the growth performance of crossbred heifers when compared with control feeding T_1.

Table 2: Effect of SSF biomass supplementation on nutrient intake, growth performance and cost of feeding in crossbred heifers

Attributes	Treatment groups		
	T_1	T_2	T_3
DM intake (g/d)	4602.34 ± 225.25	4683.60 ± 231.59	4595.14 ± 211.91
CP intake (g/d)	628.67^a ± 30.76	639.77^a ± 31.63	553.25^b ± 25.51
DCP intake (g/d)	361.49^b ± 17.59	402.42^a ± 19.89	319.78^c ± 14.74
TDN intake (g/d)	2444.30^a± 119.63	2484.18^a± 122.83	2127.09^b± 98.09
Average daily gain (kg)	0.666^b ± 0.05	0.746^a ± 0.07	0.655^b ± 0.09
Cost of feeding (Rs./kg gain)	121.40^a ± 6.77	112.93^b ± 6.00	117.91^{ab}± 8.06

T1= Control, T2 =T1 + 3% SSF, T3=T2 minus 10% CP and energy.

Means with different superscripts within a row differ significantly ($p<0.05$).

Chaudhari (2018) reported that the average daily gain of experimental crossbred calves was 655.57, 805.07 and 869.23 g/day under T_1 (control), T_2 (TMR with 50% concentrate mixture and 50% wheat straw) and T_3 (TMR with 50% concentrate mixture, 25% each pigeon pea straw and wheat straw, respectively, which differed significant ($p<0.05$). The present study was in agreement with this report. Significant difference in average daily gain was also reported by El-Kady *et al.* (2006) in buffalo male calves fed enzymatic mixture. The results are also in agreement with the findings of Balci *et al.* (2007), Malik and Bandla (2010) and Thakur *et al.* (2010). Our results also aligned with the findings of Zinn (1999), who reported improvement in average daily gain in crossbred steers fed diets containing fibroenzyme supplementation.

Cost of Feeding

The effect of feeding SSF biomass on cost of feeding in heifers presented in Table 2 revealed significantly ($p<0.05$) lower feed cost (Rs. /kg b. wt. gain) in T_2 (112.93 ± 6.00) group as compared to the T_1 (121.41 ± 6.77) and T_3 (117.91 ± 8.06) groups, where, T_1 & T_3 were statistically at par with each other. Chaudhari (2018) reported feed cost per kg weight gain to decrease significantly ($p>0.05$) by 25.25% in T_3 (TMR with 50% concentrate mixture, 25% pigeon pea straw and 25 % wheat straw) and 13.23% in T_2 (TMR with 50% concentrate mixture and 50% wheat straw) as compared to control (T_1) group, respectively.

Conclusion

The findings of the present study showed that the supplementation of SSF biomass @ 3% in the ration did not alter dry matter intake of crossbred heifers. However, the average daily gain in b. wt. (kg/day) was significantly increased with inclusion of 3% SSF (T_2 group) as compared to control group (T_1). Body weight in groups T_1 and T_3 were statistically similar suggesting that body weight gain did not alter by reduction of 10% in CP and TDN with 3% SSF supplement in T_3 group as compared to the control. The feed cost (Rs. /kg b. wt. gain) was significantly lower in T_2 as compared to control group. Hence, it can be concluded that SSF biomass can improve the growth performance of crossbred heifers without affecting the feed intake and the cost of feeding.

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ANNOUNCEMENT

X Annual Convention and National Symposium of SVSBT-2023

Extension of Date of Abstract Submission

This is to inform that on request from many participants, the last date of submission of Abstract through **e-mail svsbt2023@gmail.com is extended till 23rd September, 2023 for presentation in the *X Annual Convention*** of the Society for Veterinary Science & Biotechnology ***(SVSBT)*** and ***National Symposium on "Recent Biotechnological Advances in Health and Management of Livestock, Poultry and* Companion Animals"** to be Hosted by College of Veterinary Science & Animal Husbandry (NDVSU, Jabalpur), **Mhow, Indore, M.P. during 5th to 7th October, 2023**. The other details floated in Brochure cum Invitation remain unchanged. The abstracts received **after 23rd September, 2023 will not be entertained**.

For Further details, please contact:

Dr. R.K. Bagherwal and **Dr. B.P. Shukla**

Organizing Secretaries,
College of Veterinary Science & Animal Husbandry,
Mhow, Indore (MP), India
Whatsapp No.: 9589387634 (RKB), 9826298323 (BPS).