AGRITROPICA Journal of Agricultural Sciences

Content is available at :
https://ejournal.unib.ac.id/jagritropica
ISSN: (Print) 2621-217X, (Online) 2621-699X
Agritropica. J. Agr. Sci. 7 (1): 53-59, May 2024

Effects of Rice Green Folder on Growth Performance in Khmer native x Hariana Crossbred Cattle

Sophany Morm*, Pesith Phoeng, Chhady Khy, Senghak Khoem, Koemseang Nhuong, Vibol Peuo, Savdy Net, Sokchea Vong, Thearak Yi, and Mach Din

Department of Animal Science, Faculty of Agriculture and Food Processing, National University of Battambang 020101, Cambodia
***Corresponding author: sophanymorm@gmail.com**
Article info: Submitted: 2024-03-01, Accepted: 2024-05-15, Publish: 2024-06-15

ABSTRACT: This study aimed to assess the effect of rice green folder on growth performance in Khmer native x Hariana crossbred cattle. Twelve males of Khmer native x Harian crossbred cattle were assigned an initial body weight of 190±10 kg (IBW) with 62 days of feeding regimen and an average of 15 months of age. The dietary treatments were assigned in a completely randomized design (CRD), with three treatments of four replications, each containing four cows. Feeding treatments were as follows: 1) 100% commercial feed (Control), 2) 50% commercial feed + 50% natural grasses (NG-50), and 3) 50% commercial feed + 50% rice green folder (RGF-50). Cows were fed at 1.5% Body weight of dry matter (DM). The results indeed showed that the initial body weight (IBW) and final body weight (FBW) were non-significantly different (P>0.05). The Control group consumed the total feed intake between the groups NG-50 at 6.58 kg and 6.85 kg, which were similar amounts but higher than RGF-50, which was 5.79 kg daily a head (linear increased <0.05). Nevertheless, average daily gain (ADG) in Control, NG-50, and RGF-50 was linearly increased (P<0.05) as the ADG was 0.58, 0.46, and 0.39kg/head. FCR in the NG-50 and RGF-50 were in the same row and higher than Control, with the precious value in both NG-50 and RGF-50 at 14.90 higher than 11.45 Control (P<0.001). In conclusion, RGF-50 was a suitable roughage supply for feedlot cattle and could improve economic effectiveness. Thus, RGF was recommended for further study.

Keywords: Khmer native cattle, performance, rice green folder, natural grass, feed intake

Reference to this paper should be made as follows:
Morm, S., P. Phoeng, C. Khy, S. Khoem, K. Nhuong, V. Peuo, S. Net, S. Vong, T. Yi, and M. Din. 2024. Effects of rice green folder on growth performance in Khmer native x Hariana crossbred cattle. Agritropica. J. Agr. Sci. 7 (1): 53-59. Doi: https://doi.org/10.31186/J.agritropica.7.1.53-59.

INTRODUCTION

Meat demand in Cambodia has increased due to population growth and tourist increases annually. In rural areas, people were highly interested in animal husbandry at the time but faced technical shortages, feed and water sources, operation time, breeding, and disease influences. Furthermore, animal feed resources need to be improved (Al-Baadani et al., 2022). Most livestock farmers cropped commercial grasses to resolve the ruminant need and could supply their animals and time management but needed a huge planting area (Cantalapiedra-Hijar et al., 2018). To resolve this constraint for livestock farmers, hydroponic systems can substitute a huge area for a narrow space and supply enough feedstuff for cattle. Thus, rice green folder (RGF) is the best practice for producing feed forage with narrow land size without using soil, better germination rate, and obtaining high yield (Ata, 2016; Hafla et al., 2014). Moreover, it is costless compared to the conventional open field (Elmulthum et al., 2023; Saidi et al., 2015). Meanwhile, livestock producers face water shortages and seasonality of forage, so this method is suitable for producing feed forage (Saidi et al., 2015). Furthermore, green folder production can be protected, and the environment can control which seeds are high quality in germination, nutritious, and disease-

free feed for livestock (Bekuma, 2019). According to (Saithalavi et al., 2021), sprouts are more efficiently digested than grain seeds, and hydrolytic enzymes highly act due to germination. Sprout processing decreases phytic acid, protease inhibitor content, and some anti-nutrients (Farghalya et al., 2019), and increases crude fibre content and mineral chelates (Girma and Gebremariam, 2019). Some studies elucidated that the supply of green barley increases only animal performance. However, inadequate crude protein, energy, and mineral chelates (Sneath and McIntosh, 2003), or improved utilization of low-quality feed may be stimulated by the easily accessible nutrients in sprouted barley (Feer and Leeson, 1985).

Based on our knowledge, the rice green folder substitutes with traditional feed, which has not been extensively reported in previous studies on their performance on beef cattle. Thus, this study hypothesizes to investigate whether the RGF can be a different approach from the conventional feed for performance in Khmer native x Hariana crossbred cattle. Consequently, the main objective was to investigate the effects of freshly rice green folders and traditional feed on performance in Khmer native x Hariana crossbred cattle in this current study.

MATERIALS AND METHODS

All animal-related operations were conducted under the National University of Battambang's Animal Care and Use for Scientific Purpose Committee's guidelines, approval no. NUBB-HEIP/2021.

Chemical composition analysis

The rice green folder, commercial feed, rice straw, and natural grass were used. A 0.5 mm screen (Tecator, Hoganas, Sweden) was used to ground all samples and analyzed DM, ash, and Crude Protein (CP) (AOAC, 1990). According to Van Soest (1991), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF). Acid-insoluble ash (AIA) is an indicator used to estimate digestibility (Van Keulen and Young, 1977).

Animal, dietary treatment, and experimental design

The study was conducted at the Agricultural Research and Training Center (ARTC), National University of Battambang (NUBB), Cambodia. The rice grain was purchased from a local TAN KON Milling rice factory in Tambok Kpous village, Otambong II, Sanke district, Battambang province, Cambodia. Rice green folders were germinated under the green folder house in size (15 x 24) meters at the Agricultural Research and Training Center (ARTC), NUBB, Cambodia. The rice green folder was germinated using soaking rice grain for 24 hrs, fermenting 24 hrs, weighing fermented rice 2.0 kg, and keeping it in a tray size (0.6 x 1.2) meter. Seven days of rice green folders were separated by hand prior provided to the individual experimental cows. Twelve males of Khmer native x Hariana crossbred cattle were assigned with 190±10 kg of initial body weight (IBW), and an average of 15 months of age. The dietary treatments were assigned in a completely randomized design (CRD), with three treatments of four replications, each containing four cows. Feeding treatments were as follows: 1) 100% commercial feed (Control), 2) 50% commercial feed + 50% natural grasses (NG-50), and 3) 50% commercial feed + 50% rice greed folder (RGF-50). Cows were fed at 1.5% Body weight of dry matter (DM). RGF was germinated in the green folder house for seven days, and no water was supplied a night before providing to animals, whether NG was cut and carried around the ARTC and kept in the shade or in the dry zone to use in this study. The feedstuff was fed at 1.5% dry matter (DM) of body weight (BW) twice daily at 7:00 a.m. and 4:00 p.m. The mineral salt block and clean water were offered *ad libitum* to all cows. The cows were fed rice straw (RS) *ad libitum* daily, with 100g kg^{-1} refusal of total RS offered. RS and feeds were supplied simultaneously, although they were divided into two halves using buckets measuring 3.8 cm x 50 cm, RS feeding stock, and 30 cm x 40 cm for feeding. The cows were placed an individual pens (2.5 x 4 m) equipped with iron walls and a concrete floor. One week before the trial, the cows were given Ivermectin at 1% w/v, 1 ml/50 kg BW, and Vitamin AD_3E at 1 ml/50 kg BW.

Growth performance, feed intake, and sample collection

Growth performance

The average daily gain (ADG) was determined using the IBW and final weight (FW). According to the Kleiber ratio (Kleiber, 1947), the BW gain for the study was estimated from the ratio of BW gain to mid-point kg BW0.75 (Kelly et al., 2011). The feed conversion ratio (FCR) was computed as total DMI proportioned by total WB gain through the trial.

Feed intake and sample collection

Before experimenting, the cows were adapted in their pens for seven days to familiarize them with their living, environmental conditions, feed provider, flavor, and palatability at 66 days. The last experiment had a test feeding regimen at 62 days, and the last four days were sample collection. At the beginning of the experiment, cows were weighed to adjust feed dry matter intake (DMI) and were weighed every 14 days. Before supplying new feed, daily notes were collected to track the amount of feed consumed and refusal of feed. The Average Daily Gain (ADG) was calculated using the IBW and Final Weight (FW). The Feed Conversion Ratio (FCR) was computed as average daily feed intake (ADI)/Average daily gain (ADG) throughout the trial.

Statical analysis

The Completely Randomized Design (CRD) is a vital tool in conducting research, and it was carried out with precision and accuracy. The data was analyzed using a one-way ANOVA within the Statistical Package for the Social Sciences (SPSS), version 21 from Chicago, USA. Through UNIVARIATE, all data was tested for normal distribution, ensuring accurate results. The Ducan Multiple Ranging Test (DMRT) was employed to compare dietary treatments, ensuring that the best possible results were obtained. The significance level was set at $P<0.05$, with tendencies at $0.05<p<0.01$, ensuring the data was thoroughly analyzed. By describing the mean and standard errors as (means ± SEM), the research was conducted with the utmost professionalism and precision.

RESULTS AND DISCUSSION

Chemical composition in commercial feed, NG, RGF, and RS

Table 1 presents the chemical composition content of commercial feed, NG, RGF, and RS. The crude protein contained in the commercial feed is 15.93%, RGF is 9.60%, NG is 8.12%, and RS is 4.47%. In addition, the neutral detergent fiber revealed in the RS is higher than commercial feed, NG, and RGF. Meanwhile, acid insoluble ash (AIA) in RGF seems to be better than the commercial feed, NG, and RS at 4.84%, 5.30%, 5.25%, and 5.30%, respectively. Separately, ether extract (EE) found in RS is the lowest compared to commercial feed, RGF, and NG follows at 1.42%, 4.17%, 2.66%, and 1.72%.

The current study revealed that crude protein contents in the rice green folder were 9.60% less than reported by Hafla (2014), Saidi (2015), Mysaa (2016), Farghaly (2019), and Al-Baadani (2022), barely sprouting at 14.7%, 19.8%, 22.5%, 15.23%, and 13.86%. Still, it was similar to Gebremedhin (2015), elucidated at 10.65% of crude protein. Neutral detergent fibre is 34.23%, linked to previously reported values of 30.5%, 35.4%, 32.5%, 32.54%, and 36.90%, less than the current study at 55.46%.

Table 1. Chemical composition of commercial feed, RGF, NG, and RS

Items	Commercial feed	RGF	NG	RS
Chemical composition, % DM				
Dry matter	90.87	90.34	90.54	85.22
Ash	10.45	7.05	6.78	10.35
Organic matter	89.55	92.95	93.21	89.65
Crude protein	15.93	9.60	8.12	4.47
Neutral detergent fiber	40.69	55.46	67.01	72.41
Acid detergent fiber	22.82	36.65	38.22	57.72
Ether extract	4.17	2.66	1.72	1.42
Acid insoluble ash	5.30	4.84	5.25	5.30

Note: RS, rice straw; RGF, rice green folder; NG, natural grass; DM, dry matter

The varied nutrient composition in the rice green and barely green folders might be their time incubation or genetic resilience characteristics.

Dry matter intake in Khmer native x Hariana crossbred cattle

The current studies for the total feed intake (TFI) of Control, NG-50, and RGF-50 were 6.58, 6.85, and 5.79 kg/day, which were less than the Jiang et al. (2022), supplied HighC, concentrate to roughage ratio at 70:30 was better DMI at 6.94 kg/day. According to Mohammed (2024), wheat straw treated with urea molasses in 75% of Friesian-Borana found that 3.1 kg/head daily is a smaller amount than the current study, and it was similar to Feer and Leeson (1985) fed Autograss in 48days on beef cattle used 3.4 kg/head daily. Providing high concentrate content in the daily diet of ruminants affected fermentation and could be related to the low rumen fill effect of concentrate (Morm et al., 2023). The high concentration could be obtained effectively because it provided additional nutrients by enhancing rumen fermentation and microbial growth (Phesatcha et al., 2022). Furthermore, activating polysaccharides and glycosidase hydrolase enzymes in yeast can improve the disappearance of ruminants (Chuelong et al., 2011).

Animal growth performance characteristics of Khmer native x Hariana crossbred cattle

The growth performance characteristics of Khmer native x Hariana crossed cattle fed on dietary treatments with Control, NG-50, and RGF-50 are elucidated in Table 2. The results indeed showed that the initial body weight (IBW) and final body weight (FBW) were non-significantly different (P>0.05). The average weight gain (WG) was significantly different (P=0.001; Linnear <0.001). That Control was 35.75 kg, which is better than NG-50 (28.50 kg) and RFG-50 (24.13 kg) ahead. Nevertheless, average daily gain (ADG) in Control, NG-50, and RGF-50 was linearly increased (P<0.05) as the ADG was 0.58, 0.46, and 0.39kg/head; Control is greater than NG-50 and RGF-50.

The study found that the supplied RGF-50 was suitable for the growth performance of the calves, which can be directly related to improved dry matter feed intake. The ADG achieved from the RGF-50-based diet at 0.39 kg/day could be compared to Morm et al. (2024) and Mohammed et al. (2024). The early report by Wodajo (2021) studied post-weaning yearling crossbred calves and found that ADG was 0.28 kg/day, which is lower than the current study. The result from Aredo (2006), an FCR of 12.2, which studied crossbred calves fed urea-treated maize stover, and Mohammed et al. (2024) found that an FCR of 12.1, studied wheat straw treated with urea molasses, and Trach et al. (2001), fed urea lime treated rice straw supplemented with green feed and concentrate on crossbred calve consisted with the current study, found 14.90. These variation results could be based on the different types of feed used and the experimental time.

Effects of RGF on feed intake in Khmer native x Hariana crossbred cattle

The Control group consumed the total feed intake between the groups NG-50 at 6.58 kg and 6.85 kg, which were similar amounts but higher than RGF-50, which was 5.79 kg daily a head (linear increased <0.05). So far, FCR in the NG-50 and RGF-50 were in the same row and higher than Control, with the precious value in both NG-50 and RGF-50 at 14.90 higher than 11.45 Control (P<0.001).

Table 2. Animal growth performance characteristics of Khmer native x Hariana crossbred cattle

Variable 1.5% BW	Control	NG-50	RGF-50	SEM	NG x RGF	Contrast (p-value)	
						L	Q
Initial weight, kg	203.37	204.50	206.5	3.49	0.94	0.73	0.97
Final weight, kg	239.15	233.00	230.62	4.05	0.69	0.41	0.66
Weigh gain, kg/h	35.75^{a}	28.50^{b}	24.13^{c}	1.85	0.001	<0.001	0.45
Average daily gain, kg/h	0.58^{a}	0.46^{b}	0.39^{c}	0.03	<0.001	<0.001	0.43

Note: 1) 100% commercial feed (Control), 2) 50% commercial feed + 50% natural grasses (NG-50), and 3) 50% commercial feed + 50% rice greed folder (RGF-50); L, Linear; Q, quadratic; $^{a-c}$ Values on the same row with different superscripts differ (P<0.05); SEM, standard error mean

Effects of RGF on feed intake in Khmer native x Hariana crossbred cattle

The Control group consumed the total feed intake between the groups NG-50 at 6.58 kg and 6.85 kg, which were similar amounts but higher than RGF-50, which was 5.79 kg daily a head (linear increased <0.05). So far, FCR in the NG-50 and RGF-50 were in the same row and higher than Control, with the precious value in both NG-50 and RGF-50 at 14.90 higher than 11.45 Control (P<0.001).

Table 3. Effect of RGF on feed intake in Khmer native x Hariana crossbred cattle

Variable 1.5%BW	Control	NG-50	RGF-50	SEM	NG x RGF	Contrast (p-value)	
						L	Q
Dry matter intake (DM)							
Commercial feed							
kg/d	3.19^{a}	1.54^{b}	1.59^{b}	0.27	<0.001	<0.001	<0.001
%BW	1.44^{a}	0.71^{b}	0.73^{b}	0.12	<0.001	<0.001	<0.001
g/kg BW$^{0.75}$	52.34^{a}	25.81^{b}	26.82^{b}	4.23	<0.001	<0.001	<0.001
Rice greed folder							
kg/d	-	-	1.43	0.23	-	-	-
%BW	-	-	0.65	0.10	-	-	-
g/kg BW$^{0.75}$	-	-	24.03	3.93	-	-	-
Natural grass							
kg/d	-	2.30	-	0.30	-	-	-
%BW	-	1.05	-	0.14	-	-	-
g/kg BW$^{0.75}$	-	17.58	-	2.34	-	-	-
Rice straw							
kg/d	3.40^{a}	3.01^{b}	2.78^{b}	0.10	0.03	0.001	0.56
%BW	1.54^{a}	1.38a^{b}	1.28^{b}	0.05	0.01	0.004	0.67
g/kg BW$^{0.75}$	55.86^{a}	50.48^{b}	47.05^{b}	1.52	0.007	0.002	0.66
Total intake							
kg/d	6.58^{a}	6.85^{a}	5.79^{b}	0.17	0.01	0.01	0.04
%BW	2.98^{b}	3.13^{a}	2.65^{c}	0.07	<0.001	0.001	0.001
g/kg BW$^{0.75}$	108.20^{b}	114.75^{a}	97.89^{c}	2.29	<0.001	<0.001	<0.001
Feed conversion ratios							
(FCR)	11.45^{b}	14.90^{a}	14.90^{a}	0.59	<0.001	<0.001	<0.001

Note: 1) 100% commercial feed (Control), 2) 50% commercial feed + 50% natural grasses (NG-50), and 3) 50% commercial feed + 50% rice greed folder (RGF-50); L, Linear; Q, quadratic; $^{a-c}$ Values on the same row with different superscripts differ (P<0.05); SEM, standard error mean

CONCLUSION

The RGF-50, total feed intake used a smaller amount than NG-50 and Control groups. Nevertheless, average daily gain (ADG) in NG-50 and RGF-50 were similar precious values at 0.46, and 0.39kg/head. Furthermore, FCR in the NG-50 and RGF-50 did not vary in value. In conclusion, RGF-50 was a suitable roughage that could supply for feedlot cattle and could improve economic effectiveness. Thus, RGF was recommended for further study with Khmer native x Harian cattle.

SUGGESTION

Based on the result, RGF-50 was beneficial for cattle feedstuffs, so the author suggests that RGF-50 should be provided to female cattle to evaluate the effects of RGF. In addition, the experimental period should be more extended than the previous one to evaluate the feed quality and performance effectiveness.

Conflict of interest

The authors declare that there are no conflicts of interest.

Acknowledgment

The authors are grateful to the project Innovate CAttle FArming System: Hydroponic Fodder for Sustainable Farming in North-West of Cambodia (ICAFAS), Higher Education Improvement Project of the National University of Battambang (NUBB), for supporting our research grant. We are grateful to the nutrition lab of the Faculty of Agriculture, Ubon Ratchathani University, Warinchamrap, Ubon Ratchathani, Thailand, 34190, for supporting the lab facilitation.

Funding

The authors are grateful to the Higher Education Improvement Project (HEIP) of the Ministry of Education, Youth, and Sport, Cambodia (Credit No. 6221-KH) for the financial support of this research.

REFERENCES

AOAC., 1990. Official Methods of Analysis of the AOAC, 15th edn. Association of Official Analytical Chemists, Washington.DC.U.

Al-Baadani, H.H., Alowaimer, A.N., Al-Badwi, M.A., Abdelrahman, M.M., Soufan, W.H., & Alhidary, I.A. (2022). Evaluation of the Nutritive Value and Digestibility of Sprouted Barley as Feed for Growing Lambs: In Vivo and In Vitro Studies. Animals, 12, 1206.

Ata, M. 2016. Effect of Hydroponic Barley Fodder on Awassi Lambs Performance. Journal of Biology, Agriculture and Healthcare, 6(8): 60-64.

Aredo T. (2006). Studies on the utilization of crop residues and the potential of urea treated maize stover for cattle performances in east shoa zone, Ethiopia (doctoral dissertation. Kasetsart University).

Bekuma, A. (2019). Nutritional Benefit and Economic Value of Hydroponics Fodder Production Technology in Sustainable Livestock Production Against Climate Change - A Mini-Review. Advances in Applied Sciences, 4(1): 23-25.

Cherdthong, A., & Supapong, C. (2019). Improving the nutritive value of cassava bioethanol waste using fermented yeast as a partial replacement of protein source in dairy calf ration. Tropical Animal Health and Production, 51, 2139–2144.

Chuelong, S., Siriuthane, T., Polsit, K., Ittharat, S., Koatdoke, U., Cherdthong, A., & Khampa, S. (2011). Supplementation levels of palm oil in yeast (Saccharomyces cerevisiae) culture fermented cassava pulp on rumen fermentation and average daily gain in crossbred native cattle. Pakistan Journal of Nutrition, 10, 1115–1120.

Cantalapiedra-Hijar, G., Abo-Ismail, M., Carstens, G. E., Guan, L. L., Hegarty, R., Kenny, D. A., McGee, M., Plastow, G., Relling, A., & Ortigues-Marty, I. 2018. Review: Biological determinants of between-animal variation in feed efficiency of growing beef cattle. Animal (2018), 12:S2, s321–s335.

Elmulthum, N.A., Zeineldin, F.I., Al-Khateeb, S.A., Al-Barrak, K.M., Mohammed, T.A., Sattar, M.N., Mohmand, A.S. (2023). Water Use Efficiency and Economic Evaluation of the Hydroponic versus Conventional Cultivation Systems for Green Fodder Production in Saudi Arabia. Sustainability, 15, 822.

Feer, D.J and Leeson, S. (1985). Is there a role for hydroponics in the industry? Animal Feed Science and Technology, 13,191-202.

Farghalya, M.M., Abdullaha, M. A.M., Youssefb, I. M.I., Abdel-Rahimc, I., & Abouelezzd, K. (2019). Effect of feeding hydroponic barley sprouts to sheep on feed intake, nutrient digestibility, nitrogen retention, rumen fermentation and ruminal enzymes activity. Livestock Science, 228, 31–37.

Girma, F and Gebremariam, B. (2019). Review on Hydroponic Feed Value to Livestock Production. Journal of Scientific and Innovative Research,

7(4): 106-109.

Gebremedhin, W.K.,Deasi, B.G., & Mayekar, A.J. (2015). Nutritional Evaluation of

Hydroponically Grown Barley Fodder. Journal of Agricultural Engineering and Food Technology, 2, 2, 86-89.

Hafla , A.N., Soder , K.J., Brito, A.F., Rubano, M.D., & Dell, C.J. (2014). Effect of sprouted barley grain supplementation of a herbage-based or haylage-based diet on ruminal fermentation and methane output in continuous culture. Journal of Dairy Science, 97, 7856–7869.

Kleiber, M. (1947). Reviews 1947. Physiological Reviews, 27, 511–541.

Kelly, A.K., McGee, M., Crews, D.H., Lynch, C.O., Wylie, A.R., Evans, R.D., & Kenny, D.A. (2011). Relationship between body measurements, metabolic hormones, metabolites and residual feed intake in performance tested pedigree beef bulls. Livestock Science, 135, 8–16 (Elsevier B.V.).

Mysaa A. (2016). Effect of Hydroponic Barley Fodder on Awassi Lambs Performance.

Journal of Biology, Agriculture and Healthcare. 6, 8.

Morm, S., Lunpha, A., Pilajun, R., Cherdthong, A. (2024). Blood Metabolites, Feed Utilization and Performance in Thai Native X Lowline Angus Crossbred Cattle Fed Cassava Byproducts. American Journal of Animal and Veterinary Sciences 2024, 19, 1, 31-42.

Mohammed, K., Tamirb, B., Kitawa, G., Feyissac, F., Galmessad, U., Kehaliewa, A.,

Geletic, D., Balehegn, M., Adesogane, A.T. (2024). Feed intake and growth performance of crossbred dairy calves fed on a basal diet of wheat straw treated with urea-molasses, urea-lime, and effective microorganisms. JOURNAL OF APPLIED ANIMAL RESEARCH, 52, 1, 1-10.

Morm, S., Net, S., Vong, S., Yi, T., Khin,S., Moun, S., Sat,C., Pech,S., & Roeun. L2023.

Concentrate substituted Cassava top fermented cassava pulp in altered levels on growth performance in Thai native x Lowline Angus crossbred cattle. Agritropica: Journal of Agricultural Science. 6(2): 94- 102.

Saidi, A.R.M.A. and Abo Omar, J. (2015). The Biological and Economical Feasibility of Feeding Barley Green Fodder to Lactating Awassi Ewes. Open Journal of Animal Sciences, 5, 99-105.

Saithalavi, K. M., Bhasin, A., & Yaqoob, M. (2021). Impact of sprouting on physicochemical and nutritional properties of sorghum: a review.

Journal of Food Measurement and Characterization, 15:4190–4204

Sneath, R and McIntosh, F. (2003). Review of Hydroponic Fodder Production for Beef Cattle. Queensland. P,6.

Saidi, A.R.M.A. and Abo Omar, J. (2015). The Biological and Economical Feasibility of

Feeding Barley Green Fodder to Lactating Awassi Ewes. Open Journal of Animal Sciences, 5, 99-105.

Van Keulen, J. Y. B. A., & Young, B. A. (1977). Evaluation of acid-insoluble ash as a natural marker in ruminant digestibility studies. Journal of Animal Science, 44, 2, 282-287.

Van Soest, P. V., Robertson, J. B., & Lewis, B. A. (1991). Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. Journal of Dairy Science, 74,10, 3583-3597.

Trach, N.X., Mo, M., & Dan, C.X. (2001). Effects of treatment of rice straw with lime

and/or urea on its intake, digestibility and rumen liquor characteristics in cattle. Livest Res Rural Dev. 13,4.