Variation of Quality Parameters of Total Mixed Ration Recipe Briquettes with Extended Storage Period

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***Abstract*—Six dried Total Mixed Ration (TMR) recipes were formulated according to Completely Randomized Design and pressed into briquettes to enhance the keeping quality. All briquettes were stored for 6 months and each was analysed for physical parameters, nutrient composition and shelf life. The interaction (period x treatment) effect was not significant in nutrients except for crude protein and ash contents. It was also not significant in shelf life parameters; yeast and mould counts and total plate counts in the recipe briquettes during six months period. There was no significant interaction effect on colour parameters; lightness (l*) and yellowness (b*) however, it was higher ($p<0.05$) for redness. The interaction effect was significant ($p<0.05$) for weight- and height-loss of the TMR briquettes. Thus, these TMR recipe briquettes could be stored for up to six months without any deleterious effect on physical, nutritive- and keeping quality parameters.**

***Index Terms*—keeping quality, nutrient composition, physical parameters, shelf life**

I. Introduction

Forage production in Sri Lanka has a bimodal pattern coinciding with the rainfall pattern. It is high during the *Maha* (September to January) and *Yala* (March to June) rainy seasons [1]. Thus, the supply of forages is high during the above months and barely sufficient in other dry months February and, July to August. This inconsistent forage supply directly influences the milk production and the Body Condition Score (BCS) of the dairy cows. Therefore, forage preservation is an important strategy for consistent dairy production. During the land preparation for crop cultivation and harvesting period, the bulk of forages and crop residues are burnt and wasted. It is mainly due to negligence and also most of the farmers are not aware of the importance and quality of these crop residues and leys in crop fields [2]. Preservation of these crop residues and leys in the form of feed blocks, TMR briquettes, hay or silage would provide the required nutrients for a consistent production at forage scarce or shortage period. Above preserved forages can be incorporated in rations formulated for dairy cows according to their requirements.

Preparation of excess forage as hay (dried fodder) and silage (wet fodder) is practiced by some small and large-scale farmers in Sri Lanka [3]. At present maize (*Zea mays*), *Pennisetum perpureum x Pennisetum americarnum* hybrids; CO-3 and CO-4 and sorghum (*Sorghum bicolour*) are commonly used for silage preparation in Sri Lanka. Preparation of hay using *Brachiaria* species and Kikuyu (*Pennisetum clandestinum*) is undertaken at small-scale. These forage preservation techniques help to provide optimum nutritional value, preserve the available feed from the present to the future, and minimize the forage wastage and cost of the production. Finally, it may assist the efficient management of available limited forage sources [4].

Therefore, the preservation of excess forages and by-products for the dry season ensures uniform dairy production performances [3]. Research has shown that forages such as Gliricidia (*Gliricidia sepium*) can be preserved as a leaf meal block and use as a supplement during feed scare periods to maintain live weight gain, and milk yield of dairy cows [5], [6]. This type of leaf meal block can be prepared with or without adding industrial by-products such as coconut poonac, rice bran, and molasses [3]. The feed blocks also help to provide deficient nutrients, facilitate packaging, storage, transport, and are easy to feed the animals. The cement and molasses can be used as binders [7]. The ingredients of different blocks depend on ingredient availability, nutritive value, price, ease of handling, and quality [7].

The TMR is prepared according to the nutritional requirement of different dairy cows ensuring that each bite is nutritionally balanced [3]. Therefore, it accomplishes the daily nutritional requirement. A TMR is more palatable than individual forages. Additionally, TMR helps to minimize disorders like bloat [8] and nutritional deficiencies. Further, applying the feed block preparation principle [5] a dry TMR can be preserved in a form of a briquette to be used during feed scarce or dry periods. It

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provides a completely balanced diet thus ensure consistent production during such periods. Therefore, the milk production will not be impaired and the farmers will be able to maintain the economic benefits throughout the year [9]. Hence, the development of a higher-keeping quality TMR briquette would be a better solution to fill the feed gap during the dry spell in Sri Lanka.

Thus, this study was undertaken to find out the feasibility of preserving a TMR briquette for six months without hindering its nutritional and physical properties. The TMR briquettes were formulated using agricultural by-products and different forage species.

II. Material and Methods

A. Experimental Site

This study was conducted at the Animal Science laboratory at the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura (8.3114° N, 80.4037° E), Sri Lanka. The duration of the research was from 09th of July 2020 to 09th of January 2021.

B. Preparation of Total Mixed Ration (TMR) Briquette

Total mixed ration briquette recipes were prepared by incorporating forage species, agro-industrial by-products with or without, mineral mixture, Di-Calcium Phosphate (DCP) and molasses. The forage species were collected from the faculty premises and locally available agro-industrial by-products were purchased from milling centres in the Anuradhapura, Sri Lanka. Hybrid Napier – CO-3 (*Pennisetum perpureum X Pennisetum americarnum*), Guinea grass (*Panicum maximum*), Maize (*Zea mays*), Sorghum (*Sorghum bicolour)* and gliricidia (*Gliricidia sepium*) were collected as the forage species. The whole plant of sorghum at the pre-blooming stage and maize plant before the cob initiation were harvested. Guinea grass and CO-3 were harvested at the pre-blooming stage. Leaves and twigs of mature gliricidia trees were collected. These collected forages were cut into 2.5 cm pieces using a grass chopper and air-dried under the shade up to a moisture content of 15 – 25%. Rice (*Oriza sativa*) bran, maize (*Zea mays*) meal, coconut (*Cocos nucifera*) poonac, and soybean (*Glycine max*) meal (SBM) were grounded into a powder.

C. Preparation of Six Different TMR Recipe Briquettes

Six TMR recipes were prepared by blending the above ingredients in different ratios (Table I) for dairy cows that produce an average daily milk yield of 10 litres with 4.5% average fat content following recommendations given by Ref. [10] and Ref. [11]. The six recipes (refer to as treatments hereafter) were arranged according to Completely Randomized Design (CRD). Each treatment had four replicates.

The ingredients related to each treatment were blended using a feed mixture (Vmamix, Vietnam). Afterwards, each treatment briquette was compacted into a 1 kg briquette applying hydraulic pressure using a briquette machine (Green Pack 09, Sri Lanka). Soon after preparation, each briquette was wrapped with polythene (gauge 300) and sealed. The treatment, replicate number, date and weight related to each briquette were marked and stored at room temperature for upto 6 months.

TABLE I. Composition of Total Mixed Ration (TMR) Recipes

Ingredients (%)	T1	T2	T3	T4	T5	T6
Gliricidia	6.5	5	10	11	9	11
Guinea grass	23	17	18.5	0	21.5	14
Maize	0	24	27	11.5	16	10.5
CO-3	27	26	0	32	13	19
Sorghum	14	0	21	14	13	22
Rice bran	14	10	0	1	9.5	6.5
Maize meal	8.5	0	11.5	7.5	2.5	7
Soybean meal	5	5	6	0	2.5	3
Coconut poonac	0	5	4	14	11	5
Molasses	0	6	0	7	0	0
Mineral mixture[2]	2	0	2	0	2	0
DCP	0	2	0	2	0	2
	100	100	100	100	100	100

[1]T1 to T6 different TMR recipes
[2] Super Feed Pvt. Ltd., Sri Lanka.
(This Table is "in the press" [12])

D. Sample Analysis and Data Collection

Initially and six months later, each treatment was analysed for physical parameters (colour, weight and height), nutrient composition (dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and ash content), acid detergent fiber (ADF) and neutral detergent fiber (NDF) contents and shelf life (total plate count (TPC) and, yeast & mould count (Y&MC). The procedures of the above analyses were published [13]. Nitrogen free extract (NFE) (1), metabolizable energy (ME) (2) and total digestible nutrients (TDN) (3), (4) and (5) values were calculated using the following equations.

$$NFE\ (\%) = 100 - (Ash\ (\%) + CF(\%) + EE(\%) + CP\ (\%)) \text{ [14]} \quad (1)$$

$$ME\ (Mcal/kg) = \left(\left(1.01x(TDN\%\ x\ 0.04409)\right) - 0.45\right) \text{ [10]} \quad (2)$$

$$TDN\ (\%)\ (Dry\ forrage\ and\ roughages) = -17.26 + 1.212\ (CP) + 0.8352\ (NFE) + 2.464\ (EE) + 0.4475\ (CF) \quad (3)$$

$$TDN\ (\%)(Eergy\ feeds) = 40.26 + 0.1969\ (CP) + 0.4228\ (NFE) + 1.190(EE) - 0.1379(CF) \quad (4)$$

$$TDN\ (\%)\ (Protein\ supplements) = 40.32 + 0.5398\ (CP) + 0.4448\ (NFE) + 1.422\ (EE) - 0.7007\ (CF) \text{ [14]} \quad (5)$$

E. Statistical Data Analysis

Data related to physical properties, nutrient content, shelf life and their interaction with time were analysed according to two way ANOVA using GLIMMIX procedure in SAS (version 9.4; SAS Inst. Inc., Cary, NC). The Mean separation was undertaken using Tukey's

Studentized Range Test (TSRT). Statistical significance was considered as $p < 0.05$.

III. Result and Discussion

A. Nutrient Composition of Six Total Mix Ration (TMR) Recipe Briquettes after Six Months Storage

The interaction (period x treatment) effect was not significant in DM, EE, CF, ADF and NDF contents in the briquettes during six month period (Table II). However, the interaction effect was significant for CP and ash contents.

The DM content was significantly lower ($p < 0.05$) in all the treatments after six months storage period (86.36 ± 0.38%) compared to initial value (88.88 ± 0.38%). The mean DM loss in the present study was 2.9%. Ref. [15] observed that DM content of the baled TMR was lost with the storage due to the respiration and fermentation of ration. Ref. [16] reported that the DM losses were 2.8% and 4.2% in corn-based TMR and rice bran based TMR during 7 months storage period, respectively. When compared with the initials (3.63 ± 0.13%), EE was significantly decreased ($p < 0.05$) with the storage period and found to be 0.74 ± 0.13% after 6 months. The initial EE content in the TMR recipes ranged from 3.2% to 4.1%. The recommended level of EE content in a ruminant ration should be below 7% [17]. However, it was drastically reduced to 0.5-1.5% at six-month storage. This decrease may have resulted due to the removal of volatile substances in the TMR recipes. In contrast Ref. [15] observed that EE content continuously increased in baled TMR. They have concluded that it may be due to dry matter losses associated with respiration and fermentation.

TABLE II. Nutrient Composition of Six Total Mix Ration (TMR) Recipe Briquettes after Six Months Storage

Month	Treatments						SE	P*
	1	2	3	4	5	6		
			DM, %					
0	89.6	87.2	89.9	87.9	89.3	89.5	0.94	0.405
6	86.2	87.2	87.4	83.9	86.4	86.9		
			CP, %					
0	10.0^{d}	10.1^{d}	10.2^{d}	10.0^{d}	10.1^{d}	10.3^{d}	0.32	0.013
6	12.7^{abc}	13.7^{ab}	14.1^{a}	12.0^{c}	13.2^{abc}	12.2^{bc}		
			EE, %					
0	3.5	3.4	4.0	3.2	4.1	3.5	0.32	0.693
6	0.5	0.6	0.5	0.6	1.5	0.8		
			CF, %					
0	29.0	29.2	30.3	29.5	30.0	30.2	1.35	0.955
6	29.2	30.0	30.6	30.3	31.9	32.6		
			Ash, %					
0	11.6^{bcd}	10.0^{cd}	9.9^{d}	10.1^{cd}	11.2^{bcd}	10.1^{cd}	0.57	0.002
6	13.1^{b}	12.8^{bc}	12.0^{bcd}	16.6^{a}	13.9^{ab}	12.7^{bc}		
			ADF, %					
0	23.3	24.8	25.1	23.8	26.3	24.7	1.70	0.526
6	30.6	31.6	27.8	28.5	29.1	30.0		
			NDF, %					
0	34.1	35.5	35.0	35.1	35.1	35.4	1.39	0.788
6	36.7	36.4	37.1	35.6	34.6	35.7		

*period x treatment

a, b, c, d Mean values were significantly different within the column and row from those of the treatments and storage time: $p<0.05$.

Crude protein and ash contents were significantly higher at six month-period and the highest CP and ash contents were recorded in T3 and T4, respectively. Indirectly the increase in microbial counts may have contributed to the increase in CP and ash contents at six month-period. There was no difference ($p > 0.05$) in CF and NDF contents among the treatments at the initial and six month period. Acid detergent fibre content was significantly higher ($p < 0.05$) at six month-period (29.60 ± 0.49%) compared to the initial period (24.66 ± 0.69%). This may have resulted due to the further breakdown of cellulose and hemicellulose [15].

B. Nitrogen Free Extract (NFE%), Total Digestible Nutrients (TDN%) and Metabolizable Energy (ME Kcal/Kg) Content of the TMR Recipe Briquettes after Six Months Storage

There was no interaction (period x treatment) effect on TDN, NFE and ME in TMR recipe briquettes among the treatments at six month-period (Table III). However, at six

months NFE and TDN contents (41.99 ± 0.59% and 56.87 ± 0.40%, respectively) were significantly lower ($p < 0.05$) compared to initial values (46.09 ± 0.59% and 64.17 ± 0.40%, respectively). The TDN was calculated using the CP, NFE, EE and CF as shown in methodology [13]. Thus, the significant change in EE and CP (Table II) may have resulted in lower TDN at six-month period. However, there was no difference in ME content at six-month.

The TMR recipes were blended for a lactating dairy cow producing 10 litres of milk yield per day having an average of 4.5% milk fat. The recommended TDN and ME were 6600 g [11] and 20.86 Mcal [10], respectively. The NFC, TDN and ME contents after six-month period were lower than the recommended levels. Thus before feeding these TMR after six months, it is better to mix some of the fresh forages to enhance the palatability and quality.

TABLE III. NITROGEN FREE EXTRACT (NFE%), TOTAL DIGESTIBLE NUTRIENTS (TDN%) AND METABOLIZABLE ENERGY (ME KCAL/KG) CONTENT OF THE TMR RECIPE BRIQUETTES AFTER SIX MONTHS STORAGE

Month	Treatments						SE	P*
	1	2	3	4	5	6		
				NFE, %				
0	45.9	47.4	45.6	47.2	44.6	45.8	1.44	0.591
6	44.4	42.9	42.8	40.6	39.5	41.6		
				TDN, %				
0	63.3	64.7	65.1	64.0[a]	63.9	64.1	0.98	0.230
6	57.7	57.9	58.4	53.6	57.02	56.61		
				ME, kcal/kg				
0	2374	2437	2455	2408	2405	2413	43.90	0.230
6	2127	2138	2156	1941	2096	2078		

*period x treatment

C. *Yeast, Moulds and Total Plate Count (TPC) of the TMR Recipe Briquettes after Six Months Storage*

There was no interaction (period x treatment) effect on Y&MC and TPC of the TMR recipe briquettes after six months of storage (Table IV). At six-month period (4.80 ± 0.02 $\log_{10}$ cfu/g), the yeast count was significantly higher ($p < 0.05$) compared to the initial counts (4.48 ± 0.02 $\log_{10}$ cfu/g). According to the results of the current study, T4 had the highest ($p < 0.05$) yeast count compared to other treatments while lowest in T1. Treatment 4 had 7% molasses. Before incorporating in the TMR, it was not boiled to remove any contaminated water. The contaminated molasses may have resulted in a higher yeast count at the initial and at the end of six-month period. Present study results were in contrast with the findings of Ref. [18] who have reported that the baled semi-dry total mixed ration (TMR) during storage after 140 days, had <2.0 $\log_{10}$ cfu/g yeast count.

Mould and TPC counts at the end of the six months (4.3 ± 0.02 and 5.15 ± 0.01 $\log_{10}$ cfu/g, respectively) were higher ($p<0.05$) compared to the initial period (3.81 ± 0.02 and 4.71 ± 0.01 $\log_{10}$ cfu/g, respectively). The highest ($p < 0.05$) TPC content was observed in T4, T5 and T6 while lowest in T2. These two treatment recipes contained all four concentrate feed ingredients i.e. maize meal, soybean meal, rice bran and coconut poonac. According to, Ref. [5] TPC of coconut poonac and rice bran purchased from the market were 5.20 $\log_{10}$ cfu/g and 3.60 $\log_{10}$ cfu/g, respectively. Thus, if these ingredients were not stored properly the quality can be deteriorated due to insect attacks and, contamination with moisture. As a result, these ingredients will be attacked with yeast and moulds increasing the counts of all three contaminants, yeast, moulds and TPC.

TABLE IV. YEAST, MOULDS AND TOTAL PLATE COUNT (TPC) OF THE TMR RECIPE BRIQUETTES AFTER SIX MONTHS OF STORAGE

Month	Treatments						SE	P*
	1	2	3	4	5	6		
				Yeast ($\log_{10}$ cfu/g)				
0	4.29	4.37	4.52	4.79	4.40	4.51	0.05	0.247
6	4.62	4.79	4.81	5.04	4.83	4.72		
				Moulds ($\log_{10}$ cfu/g)				
0	3.74	3.81	3.74	3.87	3.81	3.87	0.04	0.937
6	4.19	4.30	4.23	4.38	4.34	4.34		
				TPC ($\log_{10}$ cfu/g)				
0	4.70	4.53	4.58	4.76	4.84	4.84	0.03	0.459
6	5.15	5.00	5.11	5.19	5.23	5.23		

*period x treatment

D. Physical Properties of Total Mixed Ration Briquettes in Three Months Storage

The differences in physical properties of colour, height, and weight losses of prepared TMR recipe briquettes are shown in Table V. There was no interaction (period x treatment) effect on lightness (l*) and yellowness (b*) with the respective colour. However, all three colour attributes (l*, redness (a*), and b*) were higher ($p < 0.05$) at six-month period. The l* values vary from 0 (black) to 100 (white) and it represents lightness. Also a* and b* values vary from green (- values) to red (+ values) and blue (- values) to yellow (+ values), respectively [19]. The ingredients blended in TMR recipe briquettes could wilt due to the removal of moisture. It may have caused different levels of oxidation in carbohydrates with time resulting in higher colour attributes.

The interaction (period x treatment) effect on height and weight losses of the briquettes were significant ($p < 0.05$) (Table V). Similarly, all treatments had higher height ($p < 0.05$) and weight ($p < 0.05$) losses at six-month period. Ref. [20] in their complete feed block prepared using agricultural waste also observed similar results. However, [5] did not obtain a weight loss in the leaf meal blocks prepared using different varieties of legumes. Further removal of moisture and air may have resulted in the height and weight losses in the present study.

TABLE V. PHYSICAL PROPERTIES OF TOTAL MIXED RATION BRIQUETTES IN THREE MONTHS STORAGE

Month	Treatments						SE	P*
	1	2	3	4	5	6		
				Lightness (l*)				
0	37.92	39.88	39.37	38.92	38.61	39.04	1.01	0.369
6	46.34	44.48	46.06	44.53	46.82	44.89		
				Redness (a*)				
0	3.10^{bc}	3.31^{bc}	3.00^{c}	3.21^{bc}	3.26^{bc}	3.24^{bc}	0.31	0.029
6	3.70^{abc}	4.52^{ab}	3.20^{bc}	5.20^{a}	4.16^{abc}	5.21^{a}		
				Yellowness (b*)				
0	17.84	19.46	18.91	18.37	19.18	19.11	0.84	0.862
6	19.23	21.97	20.52	21.72	21.93	21.41		
				Height reduction, %				
0	0^{c}	0^{c}	0^{c}	0^{c}	0^{c}	0^{c}	2.22	0.012
6	13.59^{ab}	11.43^{ab}	17.59^{a}	15.48^{a}	5.84^{bc}	14.97^{a}		
				Weight loss, %				
0	0^{d}	0^{d}	0^{d}	0^{d}	0^{d}	0^{d}	0.42	0.002
6	2.25^{c}	5.78^{a}	3.98^{abc}	5.29^{ab}	3.35^{bc}	4.19^{abc}		

*period x treatment

[a, b, c] Mean values were significantly different within the column and row from those of the treatments and storage time: $p<0.05$.

IV. CONCLUSION

The TMR recipe briquettes could be stored up to six months without any deleterious effect on physical, nutritive and keeping quality parameters. However, it is recommended to feed the TMR recipe briquettes either as a pulp or incorporating some green forages to enhance the palatability as the dry matter content becomes low.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Conceptualization, Deepthi Nayananjalie, Sharini C. Somasiri Jayantha B. Adikari; methodology, Wishma M. Karunanayaka, Deepthi Nayananjalie, Sharini C. Somasiri, Amali P. Kumari, Jayantha B. Adikari, Viraj R. Weerasingha and Sumudu S. Wimalasiri; investigation, Wishma M. Karunanayaka, Deepthi Nayananjalie, Sharini C. Somasiri, Amali P. Kumari, Jayantha B. Adikari and Viraj R. Weerasingha; writing-original draft preparation, Wishma M. Karunanayaka; writing- review and editing, Deepthi Nayananjalie, Sharini C. Somasiri, Amali P. Kumari, Jayantha B. Adikari and Viraj R. Weerasingha; all authors had approved the final version.

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She has worked as an Intern at Mahaweli Livestock Development Farm, Giradurukotte. Currently, she works as a Research Assistant at the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka since late July 2019. She has published her research finding around 05 full papers and her publications were related to livestock production and animal feeds Three main research publications are listed below.

1. Karunanayaka, R. H. W. M., Nayananjalie, W. A. D., Somasiri, S. C., Adikari, A. M. J. B., Weerasingha, W. V. V. R. and Kumari, M. A aA P. Nutritional and keeping quality of total mixed ration (TMR) briquettes produced for lactating dairy cows. *Sri Lankan Journal of Agriculture and Ecosystems*, Vol. 3, 2021.
2. Karunanayaka, R. H. W. M., Nayananjalie, W. A. D., Somasiri, S. C., Adikari, A. M. J. B., Weerasingha, W. V. V. R. and Kumari, M. A. A. P. Comparison of Nutritive Value in Fodder Species and Industrial By-products Available in Anuradhapura. *Journal of Dry Zone Agriculture*, Vol. 6, pp. 79-89, 2020.
3. R. H. W. M. Karunanayaka, A. M. J. B. Adikari, W. A. D. Nayananjalie and M. A. A. P. Kumari (2020). Effect of dietary probiotic, prebiotic and synbiotic supplementations on growth performance, carcass traits and serum lipid profile in broiler chicken. Rajarata University Journal, 5(2):36-44.

She is currently working on a research project on total mixed ration formulated using dried feed ingredients as a preservative technique of feeds for dairy cows and her future research is on Animal Nutrition.

Mrs. Wishma has won the 2nd Runner-up, Undergraduate 3MT (Three Minute) thesis competition 2019, Faculty of Agriculture - Rajarata University of Sri Lanka.

Deepthi Nayananjalie was bone in Kurunegala, Sri Lanka. She completed PhD from the Department of Dairy Science, Virginia Polytechnic Institute and State University, Blacksburg (VA), USA in 2012. She received MSc Degree in Biotechnology and BSc Degree in Agriculture specialized in Animal Science from the University of Peradeniya, Sri Lanka in 2004 and 2001, respectively.

She is working as a Professor in Animal Science, attached to the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka. She has been teaching Nutrition-related courses for undergraduates and postgraduates conducting research in the field of Animal Nutrition and Metabolism. She has obtained a number of research grants to carry out the research. Most of the research works have been presented at professional forums and published more than 45 research articles as full papers both in local and international reputed journals. She has reviewed many journal articles and articles in the proceedings for international and local journals. Three main research publications are listed below.

1. Souza, V. C., M. Aguilar, M. Van Amburgh, W. A. D. Nayananjalie, and M. D. Hanigan. 2021. Milk urea nitrogen variation explained by differences in urea transport into the gastrointestinal tract in lactating dairy cows, Journal of Dairy Science, 104: 6715–6726. DOI:10.3168/jds.2020-19787
2. Ranasinghe, R. A. A. S., M. P. Edirisinghe, and W. A. D. Nayananjalie. 2021. Developing a Low-fat Drinking Yoghurt by Incorporating Green Tea (Camellia sinensis) Extract as a Functional Ingredient. Asian Journal of Dairy and Food Research. 40: 100-105. DOI: 10.18805/ajdfr.DR-209
3. Sumanasekara, T. D. L. M., W. A. D. Nayananjalie, L. Ang, and M. A. A. P. Kumari. 2020. Effect of Protease Supplementation on Growth Performances, Carcass and Meat Quality Characteristics of Broiler Chicken Fed with Low Protein Diets. Sri Lankan Journal of Agriculture and Ecosystems, 2: 122–140. DOI: http://doi.org/10.4038/sljae.v2i2.42

She is currently working on a research project on total mixed rations formulated using dried feed ingredients as a preservative technique of

feeds for dairy cows. Her future research is on the possibility of incorporation of agro-industrial by-products in rations of poultry and dairy cows.

Prof. Deepthi is a member of the National Science Foundation (NSF) and Sri Lanka Association of Animal Production (SLAAP). She has participated as an invited speaker to the International Livestock Conference and 23rd Annual Convention of ISAPM, 2016 held at Hyderabad, India. During her University career, she has been awarded few fellowships; NFP Fellowship from Wageningen Centre for Development Innovation, Wageningen, Netherlands and Netherland Fellowship (OKP), Aeres University of Applied Sciences, Dronten, Netherlands.

Sharini C. Somasiri was born in Kurunegala, Sri Lanka on 26th April 1970. She has obtained her basic degree, B.Sc. Agriculture (Hons) Second Class Lower Division in July 1997 from the Faculty of Agriculture, University of Peradeniya, Sri Lanka. Her major field of study was Animal Science. She has obtained her MSc and MPhil degrees from the Postgraduate Institute of Agriculture (PGIA), University of Peradeniya, Sri Lanka in 2002 and 2010 respectively and PhD at Institute of Veterinary, Animal and Bio Medical Sciences, Massey University, New Zealand in 2014.

She has worked as a Research Officer and Senior Research Officer at the Coconut Research Institute, Sri Lanka for 10 and 2 years respectively. Currently, she works as a Senior Lecturer at the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka. She has joined the above university in late November 2017. She has already published more than 16 journal papers in peer reviewed and refereed journals. Her publications were related to livestock production, animal feeds and related areas. Three main research publications are listed below.

1. Sharini C. Somasiri, Paul R. Kenyon, Patrick C. H. Morel, Stephen T. Morris and Peter D. Kemp, (2020). Selection by Lambs Grazing Plantain (*Plantago lanceolata* L.), Chicory (*Cichorium intybus* L.), White Clover (*Trifolium repens* L.), Red Clover (*Trifolium pratense* L.) and Perennial Ryegrass (*Lolium perenne* L.) across Seasons. Animals 2020, 10, 2292; doi:10.3390/ani10122292

2. Kenyon, P. R., Morel, P. C. H., Corner-Thomas Rene Anne, Perez H. L. Somasiri, S. C., Kemp, P. D., & Morris, S. T. (2017). Improved per hectare production in a lamb finishing system using mixtures of red and white clover with plantain and chicory compared to ryegrass and white clover. Small Ruminant Research, April 2017. DOI: 10.1016/j.smallrumres.2017.04.019

3. A. M. C. S. Karunarathna, W. J. Mathurata and S. C. Somasiri (2020). Effect of two different total mixed rations (TMR) on the production performance of milking cows. Sri Lanka Journal of Animal Production. SLJAP, 12:1-10.

She is currently working on a research project on total mixed rations formulated using dried feed ingredients as a preservative technique of feeds for dairy cows. Her future research is on slow growing indigenous cross bred chicken rearing for meat purpose.

Dr. Sharini is a member of the National Science Foundation and Sri Lanka Association for the Advancement of Science. She won New Zealand Aid (Open) Development Scholarship for reading PhD at Institute of Veterinary, Animal and Bio Medical Sciences, Massey University in Feb. 2011-Sep. 2014. She has also won a Presidential award and National Research Council Merit Award, Sri Lanka for her publications in 2015 and 2016 respectively.

Jayantha B. Adikari was bone in Matale, Sri Lanka. He completed PhD degree in Comparative Genetics from the Department of Dairy Science, Virginia Polytechnic Institute and State University, Blacksburg (VA), USA in 2012. He received MSc Degree in Dairying from National Dairy Research Institute, India in 2006.

He is working as a Professor in Animal Science, attached to the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Sri Lanka. He has been teaching Animal Genetics and Breeding courses for undergraduates and postgraduates and conducting research in the field of Animal Genetics. He has obtained a number of research grants to carry out the research. Most of the research works have been presented at professional forums and published more than 40 research articles as full papers both in local and international reputed journals. He has reviewed many journal articles and articles in the proceedings for international and local journals. Three main research publications are listed below.

1. R. H. W. M. Karunanayaka, A. M. J. B. Adikari, W. A. D. Nayananjalie and M. A. A. P. Kumari (2020). Effect of dietary probiotic, prebiotic and synbiotic supplementations on growth performance, carcass traits and serum lipid profile in broiler chicken. Rajarata University Journal, 5(2):36-44.

2. L. T. Ranaweera, W. W. M. U. K. Wijesundara, H. S. M. Jayarathne, N. J. Knowles, J. Wadsworth, A. Gray, A. M. J. B. Adikari, C. K. Weebadde, S. D. S. S. Sooriyapathirana (2019). Transboundary movements of foot-and-mouth disease from India to Sri Lanka: A common pattern is shared by serotypes O and C. PLoS ONE 14(12): e0227126. https://doi.org/10.1371/journal.pone.0227126

3. L. T. Ranaweera, U. K. Wijesundara, H. S. Jayarathne, N. Knowles, J. Wadsworth, V. Mioulet, J. Adikari, C. Weebadde and S. S. Sooriyapathirana (2019). Characterization of the FMDV-serotype-O isolates collected during 1962 and 1997 discloses new topotypes, CEY-1 and WCSA-1, and six new lineages. Scientific Reports, 9:14526, https://doi.org/10.1038/s41598-019-51120-0

He is currently working on a research project on total mixed rations formulated using dried feed ingredients as a preservative technique of feeds for dairy cows. His future research is on Animal Genetics and Breeding.

Prof. Jayantha is a member of the National Science Foundation (NSF), Sri Lanka Association of Animal Production (SLAAP), Sri Lanka Association for the Advancement of Science (SLAAS).

Viraj R. Weerasingha was born in Galle, Sri Lanka on 15th July, 1990. He earned his basic degree in B.Sc. in Agriculture Technology and Management (Hons) with Second Class Upper Division (CGPA of 3.65) from Faculty of Agriculture, University of Peradeniya, Sri Lanka. He has majored in Animal Science and Technology. He completed his MSc in Food Science and Technology in Postgraduate Institute of Agriculture (PGIA), University of Peradeniya, Sri Lanka and currently he is reading his MPhil in the subject area of Animal Science in PGIA, University of Peradeniya, Sri Lanka.

He started his professional career as a demonstrator in the Department of Animal Science in Faculty of Agriculture, University of Peradeniya, later he joined as a Lecturer (Temporary) in the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka and currently he is working as a Lecturer (Probationary) in the same department since October, 2017. He has published his research finding around 08 full papers and many more conference papers. His major publication areas are related to Dairy Science including value addition of dairy products and naval dairy product developments. Recent publications are listed below.

1. Weerasingha, W. V. V. R., Ranadheera, C. S., Prasanna, P. H. P., Silva, G. L. L. P. and Vidanarachchi, J. K. Probiotic Viability and Physicochemical Properties of Set-Yoghurt Made of Indigenous and Exotic Cow Milk. Tropical Agricultural Research, 32(1): 39-48.

2. Srimali, S. V. H., Weerasingha, W. V. V. R., Nayananjalie, W. A. D., Development of drinking yoghurt by using citrus fibre as a stabilizer. Annals of Food Science and Technology, 20 (3): 420-426.

3. Kumari, G. W. S. N., Jayasumana, M. T. L. K., Edirisinghe, M. P., Weerasingha, W. V. V. R., Use of milk protein isolate to improve the textural properties of curd. Sri Lankan Journal of Agriculture and Ecosystems, 1(2): 4-13.

He is currently working on a research project on total mixed rations formulated using dried feed ingredients as a preservative technique of feeds for dairy cows. His future research is on the value addition of dairy products and naval dairy product developments.

Amali P. Kumari is from Sri Lanka. She obtained her basic degree, B.Sc. in Agricultural Technology and Management (Hons) with a First class in September 2010 from the Faculty of Agriculture, University of Peradeniya, Sri Lanka. Her major field of study was animal science. She obtained her MSc degree from the Faculty of Bio-Science Engineering, Ghent University, Belgium with a great distinction in 2015.

She is working as Lecturer at the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka. She has already published research papers in peer-reviewed journals. Her publications were related to livestock production areas. Three main research publications are listed below.

1. Nawarathne S. W. G. M. G, Kumari M. A. A. P. and Nayananjalie W. A. D. 2021. Effect of Stocking Density at Brooding Stage on Performances and Stress Response of Broiler Chickens. Rajarata University Journal, 5; 58-64.
2. Sumanasekara, T. D. L. M., W. A. D. Nayananjalie, L. Ang, and M. A. A. P. Kumari. 2020. Effect of Protease Supplementation on Growth Performances, Carcass and Meat Quality Characteristics of Broiler Chicken Fed with Low Protein Diets. Sri Lankan Journal of Agriculture and Ecosystems, 2:122-140. DOI: http://doi.org/10.4038/sljae.v2i2.42
3. R. H. W. M. Karunanayaka, A. M. J. B. Adikari, W. A. D. Nayananjalie and M. A. A. P. Kumari (2020). Effect of dietary probiotic, prebiotic and synbiotic supplementations on growth performance, carcass traits and serum lipid profile in broiler chicken. Rajarata University Journal, 5(2):36-44.

She is currently working on a research project on total mixed rations formulated using dried feed ingredients as a preservative technique of feeds for dairy cows. Her future research work on the effect of heat stress on production performances, meat quality, and welfare of broilers.

Sumudu S. Wimalasiri was born in Rambukkana, Sri Lanka on 11th September 1993. She obtained her basic degree, B.Sc. Agriculture Second Class Lower Division in July 2020 from the Faculty of Agriculture, Rajarata University of Sri Lanka. Her major field of study was animal production and technology. She is currently reading for her MSc. in Biotechnology at the Post Graduate Institute of Agriculture, University of Peradeniya, Sri Lanka.

She works as a Teaching Assistant (Temporary) at the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka. She joined the above university in late September 2020. She has published two abstracts and her publications were related to livestock production and animal feeds. The publications are listed below.

1. Wimalasiri, K. S. S., Somasiri, S. C., Ekanayake, N., Ensiling Fruit Peels of Pineapple and Papaya for the Utilization as an Animal Feed. Annual Research Symposium, Faculty of Agriculture, Rajarata University of Sri Lanka, 2020.
2. Wimalasiri, K. S. S., Somasiri, S. C., Ensiled Fruit Peels of Pineapple (*Ananas comosus*) and Papaya (*Carica papaya*) as an Animal Feed. The 2nd International Conference on Agriculture, Food Security and Safety, AgroFood 2021, 15th-16th January 2021, Online.

Ms. Sumudu has won the best presenter award for the presentation entitled "Ensiled Fruit Peels of Pineapple (*Ananas comosus*) and Papaya (*Carica papaya*) as an Animal Feed" in the session of "Food Science & Produce" at the 2nd International Conference on Agriculture, Food Security and Safety 2021 ("COVID 19: Impact and Challenges for Global and National Level Food Security, Nutrition and Health") held on 15-16 January 2021, Online.