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Evaluation of the effect of soy protein isolate based milk replacer feeding on digestibility of nutrients and haematobiochemical parameters in cross bred calves#

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Abstract

A study was conducted in crossbred calves for a period of 90 days to evaluate the effect of soy protein isolate based milk replacer feeding on digestibility of nutrients and haematobiochemical parameters.Twelve,four-day-old crossbred calveswere selected from University Livestock Farm and Fodder Research and Development Scheme (ULF & FRDS), Mannuthy and were allotted to one of the two dietary treatments. The dietary treatments were T1 (Control) fed with whole milk and T2- fed with soy protein isolate based milk replacer (CP-22 per cent) and milk in the ratio 3:1.To all the experimental animals, calf starter (CP-23 per cent) and adlibitum green grass were offered and were fed according to ICAR (2013). Daily record of quantity of feed (calf starter and milk replacer) andgrass given and balance if any were recorded throughout the experimental period. A digestibility trial for five days duration was carried out towards the end of feeding trial by total collection method. The results revealed similar apparent digestibility of nutrients and haematobiochemical parameters for whole milk and milk replacer fed group.

Keywords: *Whole milk, soy based milk replacer, digestibility, haematological parameters*

Calf nutrition plays a crucial role in the successful calf rearing. It is very much important to ensure the proper growth and development in calves. Whole milk can be considered as the ideal source of nutrition for the calves in their early life. Protein with good quantity and quality should be

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incorporated in the diets of the calves to ensure ideal growth rate (Jasmine *et al.,* 2016). Even though the roughages provided to the calves are rich in crude fibre, they are having very low crude protein level (Neenu *et al.,* 2022). Thus, the calf starter and the milk or milk replacer given to the calves should provide the required protein for growth and development.

In order to maximise the profits, most farmers adopt a reduced milk feeding strategy which makes the calf undernourished and leads to increased calf mortality rates (Uetake *et al.,* 2013). Milk replacers can be considered as a partial replacement to whole milk feeding and thereby can reduce the cost of calf rearing. Alternative protein sources were introduced to the milk replacers to reduce the cost of production. The reduced apparent digestibility of the plant protein sources can cause increased incidence of diarrhoea in calves (Godden *et al.,* 2005). Hence this study is to formulate a milk replacer with soy protein isolate and to evaluate the effect of milk replacer feeding on the digestibility of nutrients and hematobiochemical parameters.

Materials and methods

Twelve, four-day-old crossbred calves of either sex, after colostrum feeding were selected from University Livestock Farm and Fodder Research and Development Scheme (ULF & FRDS), Mannuthy. They were divided into two groups of six animals each and were allotted randomly with regard to their body weights to one of the two dietary treatmentsT1 and T2.

Experimental feed

The experimental calves were maintained on the following feeding regimes for a period of three months.

T1 (Control)- Calves were fed with milk at 1/10th of body weight during first six weeks, 1/15th during next two weeks, 1/20th during next four weeks.

T2- Soy protein isolate based milk replacer (CP-22 per cent) were reconstituted with water (1-part dry milk replacer with 7 parts warm water) just before feeding to obtain 12 per cent of total solids and this was fed from 5th day onwards in the ratio of 1:3 along with milk and was gradually raised to a ratio of 3:1 by the 10th day. This was fed at a rate of 1/10th of body weight during first six weeks, 1/15th during next two weeks and 1/20th during next four weeks. The formulated milk replacer contained dried whey (52 parts), milk powder (12 parts), soy protein isolate (16 parts), and coconut oil (15 parts) as the major ingredients.

To all the experimental animals, calf starter (23 per cent CP and 70 per centTDN) was offered. The calf starter was made with maize (35 parts), coconut oil cake (5 parts), soy bean meal (29 parts), gingelly oil cake (9 parts), and wheat bran (20 parts) as the major ingredients. Clean fresh drinking water and green grass were offered to all the animals *ad libitum.*

Feeding and digestion trial

Feeding trial was conducted for a period of 90 days using milk, milk replacer, calf starter and green grass.Daily records of quantity of feed (calf starter and milk replacer) and grass given and balance if any were recorded throughout the experimental period.A digestibility trial for five days duration was carried out towards the end of feeding trial by total collection method. During the digestion trial, quantities of daily feed offered, dungvoided and residue of feed and fodder left were recorded. Representative samples of feed and fodder offered were taken daily during the trial period for proximate analysis. Dry matter content of the feed and fodder offered as well as the residue was determined daily. Dung samples were collected in double lined polythene bags and stored for analysing proximate principles as per standard procedure (AOAC, 2016).

Haemato-biochemical parameters

Blood samples were collected from all the animals at the end of the feeding trial.Whole blood was used to determine the haemoglobin (cyan methaemoglobin method) and serum samples were used to determine serum protein (Jong and Vegeter, 1950), glucose (GOD-PAP

methodology), calcium (AOAC, 2016) and phosphorus (Bernhart and Wreath, 1955) using standard kits.

Statistical analysis

Statistical analysis was done by usingt test (Snedecor and Cochran, 1994). Analysis was done in SPSS 24.0.

Results and discussion

The composition of milk offered to the experimental calves are given in Table 1. The chemical compositions of milk replacer, calf starter and green grass offered to the experimental animals were given in Table 2. The chemical composition of the dung of experimental calves are given in Table 3.

The digestibility coefficient of nutrients of the calves maintained on two experimental rations are presented in Table 4. The digestibility coefficient of nutrients were found to be 76.49±1.22 and 75.09±0.70 per cent for DM,78.23±0.39 and 76.73±0.49 per cent for CP,80.65±1.33 and 79.28±0.88 per cent for EE,66.76±1.04 and 65.34±0.42 per cent for CF,80.96±0.83 and 78.25±0.86 per cent for NFE, 69.32±1.78 and 67.50±1.47 per cent for NDF, 51.80±1.28 and 48.72±0.92 per cent for ADF respectively, for T1 and T2.

On statistical analysis, it was observed that the dry matter digestibility coefficient was similar among the treatments. Present results were in agreement with Ghosh *et al.* (2011), in which they observed similar values for the digestibility coefficient of dry matter between the control and treatment groups. Kamalahasan (2018) observed similar dry matter digestibility coefficient values for milk and milk replacer fed groups irrespective of the level of solid feed intake. However,Terre *et al.* (2007) observed that the digestibility coefficient for dry matter was higher for whole milk fed group than the milk replacer fed group.

On statistical analysis, similar digestibility coefficient values for crude protein were observed. Present results were in accordance with Kamalahasan (2018) in which he reported digestibility coefficient values for crude protein as78.71±2.02, 77.89±1.46 and 78.57±1.61 per cent, respectively for whole milk, commercial milk replacer and formulated milk replacer fed groups. Dhanya (2022) also observed similar values for the crude protein digestibility coefficient among the treatments. However, Hill *et al.* (2010) recorded that the crude protein digestibility was higher for the calves fed with more amount of whole milk than the milk replacer.

The calculated ether extract digestibility was similar between T1 and T2 on statistical analysis.The present results were in accordance with,Jasmine *et al.* (2007), in which they observed similar values among the treatments. Kamalahasan (2018) from his studies reported 88.01, 85.75 and 87.33 per cent as the digestibility coefficient values for ether extract, respectively for whole milk, commercial milk replacer and formulated milk replacer fed groups. However, Terre *et al.* (2007) observed higher ether extract digestibility coefficient values for whole milk fed group than for milk replacer fed group.

On statistical analysis, similar apparent digestibility values for crude fibre were observed among the treatments. Present results were in agreement with Kamalahasan (2018) in which he got 70.85 and 68.45 per cent respectively for whole milk and milk replacer fed groups. Likewise, Dhanya (2022), also observed similar results for the digestibility coefficient of crude fibre among the treatments. On contrary to the present results, Hill *et al.* (2010) observed a lower crude fibre digestibility coefficient value for milk replacer fed group than the milk fed group.

Digestibility coefficient values for nitrogen free extract were found to be similar across the treatments. The present results were in agreement with Kamalahasan (2018), in which he obtained 79.78 and 79.71 per cent as digestibility coefficient values for nitrogen free extract for whole milk and milk replacer fed groups, respectively. On contrary to this result, Dhanya (2022) observed a higher digestibility coefficient value for nitrogen free extract for milk fed group (81.98 per cent) than for milk replacer fed group (77.06 per cent).

On statistical analysis, the calculated neutral detergent fibre digestibility was observed as similar between T1 and T2.Present results were in agreement with, Dhanya (2022) in which they observed similar results in the digestibility coefficient values for neutral detergent fibre among the milk fed and milk replacer fed group. On contrary to this result, Terre *et al.* (2007) observed lower apparent digestibility of neutral detergent fibre for milk replacer fed calves than the milk fed group.

Through statistical analysis, similar apparent digestibility values for acid detergent fibre were observed among the treatments. Dhanya (2022) observed that the digestibility coefficient values for acid detergent fibre was higher for milk fed group (59.91 per cent) on comparison with the milk replacer fed group(53.98 per cent).

Haematobiochemical parameters of the calves maintained on the two experimental rations were analysed at the end of the feeding trial and given in the Table 5. The values of hematological parameters for treatment groups belonging to T1 and T2 recorded at the end of the trial were 12.21±0.13 and 12.25±0.15 g/dL for haemoglobin, 6.49±0.11 and 6.63±0.18 g/dL for serum protein, 61.32±0.94 and 61.84±0.73 mg/dL for serum glucose, 11.40±0.16 and 11.38±0.19 mg/dL for serum calcium, 6.38±0.11 and 6.40±0.06 mg/dL for serum phosphorus, respectively.

Through statistical analysis, it was observed that the average heamoglobin concentrations were similar across the treatments.The present results were in accordance with Shakya *et al.* (2017) in which they observed similar initial and final haemoglobin levels for calves fed with soy based milk replacer at different levels. Similar results were obtained for Dhanya (2022) in which she got 12.34and12.2g/dL respectively for whole milk and milk replacer fed groups.

On statistical analysis, serum protein levels were found to be similar among the treatments.The present results were in accordance with Quigley *et al.* (2006), in which they observed similar values among the treatments for serum protein levels. Similar results were obtained for Kamalahasan (2018) in which he got a serum protein range of 6.58 to 6.09 g/dL for the experimental animals.

Through statistical analysis, similar serum glucose levels were observed among the treatments. Lee *et al.* (2008) observed a similar blood glucose level between the calves fed with whole milk and milk replacer.

Table 1. Composition[1] of milk offered to the experimental calves, %

Components	Percentage
Total solids	12.51 ± 0.22
SNF	9.04 ± 0.21
Fat	3.47 ± 0.01
Protein	3.11 ± 0.04

[1]Mean values are based on six replicates

Table 2. Chemical composition[1] of milk replacer, calf starter and green grass fed to the experimental calves, %

Parameter	Milk replacer	Calf starter	Green grass
Dry matter	92.02 ± 0.24	90.22 ± 0.43	19.91 ± 0.26
Crude protein*	22.24 ± 0.88	23.07 ± 0.56	9.03 ± 0.76
Crude fibre*	2.48 ± 0.30	5.30 ± 0.47	29.89 ± 0.47
Ether extract*	18.07 ± 0.60	4.11 ± 0.24	1.48 ± 0.33
Total ash*	5.91 ± 0.49	8.49 ± 0.19	10.43 ± 0.57
Nitrogen free extract*	51.75 ± 0.79	58.35 ± 0.64	48.92 ± 0.75
Neutral detergent fibre*	11.15 ± 1.02	23.03 ± 0.74	63.58 ± 1.19
Acid detergent fibre*	6.20 ± 1.10	13.97 ± 0.67	47.60 ± 1.17
Acid insoluble ash*	1.07 ± 0.34	1.78 ± 0.45	1.32 ± 0.33
Calcium*	1.27 ± 0.11	1.70 ± 0.07	0.60 ± 0.19
Phosphorus*	0.648 ± 0.13	0.77 ± 0.04	0.29 ± 0.08

[1]Mean values are based on six replicates, *On DM basis

Kamalahasan (2018) obtained a range of 64.90 to 65.03 mg/dL for the serum glucose levels of the experimental animals.

The serum calcium levels from the present study were similar across the treatments on statistical analysis. Similar results were obtained for Kamalahasan (2018) and Dhanya (2022) in which they observed similar values among the treatments for the serum calcium level. On contrary to the present result, Shukla *et al.* (2016) stated that the serum calcium levels differed significantly among the whole milk and milk replacer fed groups. They observed higher serum calcium levels for the whole milk fed group.

On statistical analysis, similar serum phosphorus levels were observed among the treatments. Kamalahasan (2018) obtained serum phosphorus level as 6.77 and 6.18 mg/dL respectively, for whole milk and milk replacer fed groups.

Table 3. Chemical composition[1] of dung of the calves maintained on two experimental rations, %

Parameters	Dietary Treatments	
	T1	T2
Dry matter	20.04 ± 0.27	19.08 ± 0.19
Crude protein*	15.72 ± 0.21	17.12 ± 0.13
Crude fibre*	23.37 ± 0.37	24.24 ± 0.41
Ether extract*	1.85 ± 0.25	1.30 ± 0.26
Total ash*	10.80 ± 0.34	11.81 ± 0.54
Nitrogen free extract*	45.64 ± 0.77	46.20 ± 0.70
Neutral detergent fibre*	53.24 ± 0.48	57.87 ± 0.41
Acid detergent fibre*	44.37 ± 0.67	47.53 ± 0.54
Acid insoluble ash*	3.70 ± 0.44	4.01 ± 0.36
Calcium*	1.41 ± 0.44	1.34 ± 0.21
Phosphorus*	0.77 ± 0.74	0.74 ± 0.56

[1]Mean values are based on six replicates, *On DM basis

Table 4. Data on the digestibility coefficient[1] of nutrients of the calves maintained on the two experimental rations, %

Parameters	Dietary Treatments		p value
	T1	T2	
Dry matter	76.49 ± 1.22	75.09 ± 0.70	0.689^{ns}
Crude protein	78.23 ± 0.39	76.73 ± 0.49	0.182^{ns}
Crude fibre	66.76 ± 1.04	65.34 ± 0.42	0.424^{ns}
Ether extract	80.65 ± 1.33	79.28 ± 0.88	0.159^{ns}
Nitrogen free extract	80.96 ± 0.83	78.25 ± 0.86	0.101^{ns}
Neutral detergent fibre	69.32 ± 1.78	67.50 ± 1.47	0.094^{ns}
Acid detergent fibre	51.80 ± 1.28	48.72 ± 0.92	0.073^{ns}

[1]Mean values are based on six replicates, ns-non significant ($p > 0.05$)

Table 5. Haematobiochemical parameters[1] of the calves maintained on the two experimental rations

Parameters	Dietary Treatments		p value
	T1	T2	
Haemoglobin (g/dL)	12.21 ± 0.13	12.25 ± 0.15	0.950^{ns}
Serum protein (g/dL)	6.49 ± 0.11	6.63 ± 0.18	0.194^{ns}
Serum glucose (mg/dL)	61.32 ± 0.94	61.84 ± 0.73	0.462^{ns}
Serum calcium (mg/dL)	11.40 ± 0.16	11.38 ± 0.19	0.273^{ns}
Serum phosphorus (mg/dL)	6.38 ± 0.11	6.40 ± 0.06	0.157^{ns}

[1]Mean values are based on six replicates, ns-non significant ($p > 0.05$)

Conclusion

The apparent digestibility of nutrients was observed to be similar for whole milk and soy protein isolate based milk replacer fed group. Soy protein isolate based milk replacer could produce a similar haematobiochemical values like the whole milk feeding in calves. Soy based milk replacer can be successfully used as a partial replacement for whole milk.

Conflict of interest

The authors declare that they have no conflict of interest.

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