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Comparative nutritional worth and economics of feeding soya pulp in lactating animals

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Abstract
In the present study grains, oil seed cakes, agroindustrial by-products and soya pulp were analysed for proximate principles, cell wall constituents and mineral content (Ca and P). Twenty cows of same parity, age and average milk yield (15-25 litres per day) were distributed in four treatment groups (T_1, T_2, T_3 and T_4) of five animals each. Cows in all the groups were fed basal diet consisting of maize fodder, maize silage, concentrate mixture and wheat straw as per NRC (2001). The soya byproducts (soybean cake and full fat soya) in the concentrate mixture were replaced with soya pulp at 0%, 10%, 20% and 30% levels on N-basis in groups T_1, T_2, T_3 and T_4, respectively. All the diets were iso-nitrogenous. The animals of group T_1 served as control. Economics of replacement of soya byproducts in the concentrate mixture with soya pulp was calculated. It was concluded that soya pulp supplementation reduced the cost of feed and milk production.

Keywords: Proximate principles, soya pulp, soya byproducts, economics

Introduction
For sustaining profitability of a livestock enterprise balanced and economic feeding is must, as feed contributes 60-65% of the total expenditure. According to the report of the Planning Commission (2012) [3], Government of India, our country is highly deficient in respect of availability of green fodder (35%), dry fodder (10%) and concentrates (33%) and this deficit is expected to increase in upcoming years as productive livestock population and productivity is in increasing trend. Concentrates are the costly component in livestock sector not only due to costly ingredients used but for food-feed competition between human and livestock. To overcome these problems, we need to tap new unconventional feed resources as livestock feed. Soya pulp, namely, okara in Japanese, is one such byproduct that could be utilised in animal feeding. It is generated during production of soya milk and soya curd (tofu).
Soya pulp is a good source of protein and fibre and is palatable to animals. Rahman *et al.* (2015) [5] reported that soya pulp contains DM about 223.2 ± 9.4 g/kg of feed, 965.9 ± 2.5 g/kg of feed OM, 219.9 ± 11.2 g/kg of feed protein, 278.1 ± 31.5 g/kg of feed NDF and other essential nutrients. Therefore, it can replace part of soybean in cattle, pig, goat, chicken and fish feeding. There is immense potential to utilise soya pulp in cattle feeding as a replacement of soybean and other conventional protein sources to reduce the cost of feeding. For exploring the application of soya pulp in animal feeding, nutritional characteristics of soya pulp and other commonly utilised feed ingredients were analysed and economics of incorporation of soya pulp as a replacement of soya byproducts (soybean cake and full fat soya) in concentrate mixture was calculated.

Materials and methods
The samples *viz*. maize, bajra, wheat, mustard cake, mustard cake-deoiled (DOMC), soya bean cake, full fat soya, cotton seed, pulse churi, guar korma, deoiled rice bran (DORB), and soya pulp were collected from the local market of Ludhiana and Sangrur, dried in a hot air oven at 60ºC until constant weight, ground to pass through 1mm sieve using electrically operated Willey mill and stored in plastic sample bottles for further analysis. The proximate principles (AOAC, 2005) [1], fiber composition (Van Soest *et al.* 1991) [6] and Ca and P (Talpatra *et al.* 1940) [7] of feed samples were analyzed.
In the next step, a sixty two days feeding trial was conducted on twenty healthy dairy cows of same parity, age and average milk yield (15-25 litres per day) at a private dairy farm, village Dehkalan, District Sangrur, Punjab. Cows in all the groups were fed basal diet consisting of maize fodder, maize silage, concentrate mixture and wheat straw as per NRC (2001) [1]

requirements. The soya byproducts (soybean cake and full fat soya) in the concentrate mixture were replaced with soya pulp at 0%, 10%, 20% and 30% levels (on N-basis) in groups T_1, T_2, T_3 and T_4, respectively. The animals of group T_1 served as control. All the diets were iso-nitrogenous. Dried soya pulp was obtained from a producer in Deh kalan village of District Sangrur. Economics of replacement of soya byproducts in the concentrate mixture with soya pulp was calculated according to the current market prices.

Results and discussion

The chemical composition of various ingredients used in trial comparative to soya pulp has been represented in Table 1. Among the grains, the organic matter (OM) content was higher in maize (97.90%) and wheat (97.82%) but bajra (97.43%) had lower value. CP content was higher in bajra (12.04%) than wheat (11.14%) than maize (10.90%). The fat content was higher in bajra (5.34%) followed by maize (3.82%) and wheat (2.34%). Crude fibre content was lower in wheat (1.88%) but maize and bajra had similar values. Total ash values were comparable. Value of AIA was also higher in bajra (0.76%) in comparison to wheat (0.46%) and maize (0.32%). NFE content was high in maize (81.06%) and wheat (82.46%) but bajra comparatively had a lower value (77.94%). NDF content was higher in bajra (37.28%) followed by maize (33.83%) and wheat (28.61%). ADF value was also higher in bajra (12.45%) followed by and maize (6.50%) wheat (6.13%). Calcium content was lower in wheat (0.03%) but maize and bajra had comparable values. Phosphorus content was high in bajra (0.64%) than wheat (0.40%) and maize (0.38%). The results of CP%, EE%, TA% and ADF% for maize are lower but NDF% is higher than the findings of Prusty *et al* (2013) [4]. The value of CP% is on lower side but values of EE%, TA%, NDF% and ADF% are higher for bajra in comparison. For wheat, values of CP% is lower but NDF% is higher in comparison.

Among oil seed cakes, organic matter varied from 84.58% (mustard DOC) to 93.79% (full fat soya). CP content varied from 38.80% (mustard cake) to 46.72% (soybean cake). EE values were in the range of 0.92% (mustard DOC) to 9.34% (mustard cake). Crude fibre content varied from 5.13% (mustard cake) to 10.16% (mustard DOC). Total ash values varied from 6.21% (soybean cake) to 15.42% (mustard DOC). AIA content varied from 1.61% (mustard cake) to 4.43% (mustard DOC). NFE values were in the range of 31.86% (mustard DOC) to 39.76% (mustard cake). NDF content varied from 25.87% (mustard cake) to 30.12% (mustard DOC). Values of ADF were in the range of 13.92% (soybean cake) to 19.56% (mustard cake). Ca content varied from 0.43% (soybean cake) to 0.77% (mustard DOC). Content of P was in the range of 0.64% (soybean cake) to 1.73% (mustard DOC). When compared to findings of Prusty *et al* (2013) [4], in case of mustard cake, CP%, EE% and NDF% are higher but EE% and ADF% have lower value. In case of mustard DOC, CP%, TA% and NDF% are higher but EE% and ADF% have lower values. Soybean cake has similar values except ADF% (lower value in comparison).

Among agroindustrial by-products, organic matter varied from 89.90% (DORB) to 97.28% (full fat soya). CP content varied from 17.90% (DORB) to 50.28% (guar korma). EE values were in the range of 1.92% (DORB) to 18.94% (cotton seed). Crude fibre content varied from 6.73% (full fat soya) to 27.41% (cotton seed). Total ash values varied from 2.72% (full fat soya) to 10.10% (DORB). AIA content varied from 0.17% (guar korma) to 1.65% (soya pulp). NFE values were in the range of 26.97% (cotton seed) to 58.85% (DORB). NDF content varied from 11.10% (full fat soya) to 72.60% (soya pulp). Values of ADF were in the range of 5.90% (full fat soya) to 37.00% (soya pulp). Ca content varied from 0.25% (full fat soya) to 2.69% (pulse churi). Content of P was in the range of 0.12% (pulse churi) to 1.73% (DORB). When compared to findings of Prusty *et al* (2013) [4], in case of pulse churi, content of NDF%, ADF% and TA% are higher but CP% and EE% have comparatively lower values. For guar korma NDF% and EE% are higher, but CP% is less in comparison. For DORB, values of EE% and TA% are lower but CP%, NDF% and ADF% are higher in comparison.

Physical composition of concentrate mixtures used in the experiment has been represented in Table 2. Intake of maize fodder, maize silage, wheat straw and concentrate for each group was calculated (Table 3). Cost per kg of concentrate for T_0, T_1, T_2 and T_3 groups were Rs. 19.30, 18.83, 18.36 and 18.27 respectively. Accordingly cost of concentrate per day for T_0 group was Rs. 158.26, for T_1 group was Rs. 154.42, for T_2 group was Rs. 161.57 and for T_3 group was Rs. 153.47. Cost of fodder each day for T_0, T_1, T_2 and T_3 groups were Rs. 19.65, 19.65, 23.15 and 21.05 respectively. Therefore, cost of feed per day for T_0 group was Rs. 177.91, T_1 group was Rs. 174.07, T_2 group was Rs. 184.72 and for T_3 group was Rs. 174.52.

Profit gained in case of T_0 group, by selling of milk at Rs. 240/kg of fat and Rs. 170/kg of SNF was Rs. 529.40, for T_1 group was Rs. 530.36, for T_2 group was Rs. 565.20 and for T_3 group was Rs. 542.70. Therefore, the net profit gained by the farmer was Rs. 351.49, Rs. 356.29, Rs. 380.48 and Rs. 368.18 for T_0, T_1, T_2 and T_3 groups respectively. There was net profit of Rs. 0.24, Rs. 1.45 and Rs. 0.84 in T_1, T_2 and T_3 groups compared to control. It was concluded that soya pulp supplementation reduced the cost of feed and milk production. Also, there was more profit in soya pulp supplemented groups.

Table 1: Proximate principles, cell wall constituents and mineral content (Ca and P) of feed ingredients

Composition (%)	Maize	Bajra	Wheat	Mustard cake	Mustard DOC	Soybean cake	Full fat soya	Cotton seed	Pulse churi	Guar korma	DORB	Soya pulp
DM	89.16	90.13	89.54	92.23	90.12	90.62	92.71	91.89	88.64	90.17	87.45	91.50
OM	97.90	97.43	97.82	93.03	84.58	93.79	97.28	95.50	91.50	94.79	89.90	95.63
CP	10.90	12.04	11.14	38.80	41.64	46.72	37.14	22.18	18.14	50.28	17.90	23.07
EE	3.82	5.34	2.34	9.34	0.92	1.16	18.82	18.94	5.34	6.23	1.92	4.37
CF	2.12	2.11	1.88	5.13	10.16	7.83	6.73	27.41	12.67	7.78	11.23	26.32
TA	2.10	2.57	2.18	6.97	15.42	6.21	2.72	4.50	8.50	5.21	10.10	4.34
AIA	0.32	0.76	0.46	1.61	4.43	2.63	0.35	1.23	0.21	0.17	1.51	1.65
NFE	81.06	77.94	82.46	39.76	31.86	39.08	34.59	26.97	55.35	30.50	58.85	41.87
NDF	33.83	37.28	28.61	25.87	30.12	28.83	11.10	48.74	38.23	25.43	54.18	72.60
ADF	6.50	12.45	6.13	19.56	16.87	13.92	5.90	32.34	15.50	12.65	20.25	37.00
Ca	0.23	0.27	0.03	0.62	0.77	0.43	0.25	1.60	2.69	1.21	0.35	1.52
P	0.38	0.64	0.40	1.39	1.73	0.64	0.58	1.54	0.12	0.73	1.73	0.93

Table 2: Physical composition of concentrate mixtures used in the experiment

Ingredients (kg/100kg)	T_1	T_2	T_3	T_4
Maize	19.5	20.43	22.80	24.17
Bajra	20.00	20.00	20.00	20.00
DORB	11.55	12.56	9.84	7.08
Molasses	3.50	3.50	3.50	3.50
Mustard Cake	8.00	8.00	8.00	8.00
Mustard DOC	9.00	9.00	9.00	9.00
Cotton seed	2.25	2.25	2.25	2.25
Soybean Cake	6.00	4.90	4.40	4.00
Full fat soya	5.00	4.35	1.50	0.20
Gram Churi	4.00	-	-	-
Guar korma	6.00	6.00	6.00	6.00
Urea	0.40	0.40	0.40	0.50
Bypass fat	0.25	0.25	0.25	0.25
Calcite powder	2.24	2.27	2.27	2.10
Premix[1]	1.00	1.00	1.00	1.00
DCP	0.15	0.15	0.30	0.50
Salt	1.20	1.20	1.20	1.20
Soya pulp	**-**	**3.75**	**7.30**	**10.25**

[1]1 kg Premix contains: Yeast 100g, Toxin binder 100g, Vitamins 5g, Electrolytes 100g, Trace minerals 105g, chelated minerals 50g and buffer 390 g respectively.

Table 3: Economic evaluation of replacement of soya byproducts in the concentrate mixture with soya pulp

	T_0	T_1	T_2	T_3
Concentrate intake/day (kg)	8.20	8.20	8.80	8.40
Cost of 100 kg concentrate (Rs)	1930.18	1882.48	1836.31	1827.18
Cost of concentrate/kg (Rs)	19.30	18.83	18.36	18.27
Cost of concentrate/day (Rs)	158.26	154.42	161.57	153.47
Fodder intake/day (kg)	33.00	33.00	38.00	35.00
Cost of fodder/day (Rs)	19.65	19.65	23.15	21.05
Cost of feed/day (Rs)	177.91	174.07	184.72	174.52
Milk yield/day (kg)	20.99	20.90	22.37	21.34
Milk fat%	4.10	4.10	4.07	4.13
Milk SNF%	9.06	9.14	9.11	9.14
Total money/day accrued (Rs)	529.40	530.36	565.20	542.70
Net profit/day (Rs)	351.49	356.29	380.48	368.18
Net profit/day/ animal (Rs)	17.57	17.81	19.02	18.41
Net profit compared to control (Rs)	-	0.24	1.45	0.84

Conclusions

From the nutritional characterisation of soya pulp and various feed ingredients it was concluded that it is comparable to other agroindustrial by-products such as pulse churi and DORB. It is economical to use in dairy cattle feeding as a replacement of other soya byproducts.

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