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Green Pea Pod Residue-As an Alternative Feeds for Dairy Animals: A Review

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ABSTRACT

Livestock gives a substantial contribution in sustaining rural economy and livelihood and up liftment of socio-economic status of rural people. The contribution is nearly 4.11 per cent to total GDP and 25.6% of total Agriculture GDP. Present livestock population of 535.78 million registered an increase of 4.6% over Livestock Census 2012. In India availability of feed stuffs both in quantitative and qualitative forms has been the major constraint for sustaining positive growth in Indian livestock sector. Latest estimate on demand-supply gap in fodder availability shows a net deficit of 30.65% green fodder and 11.85% dry crop residues in year 2020. Pea seeds are regarded as a highly valuable protein source for nutrition due to their high protein content (about 22-24%) which is intermediate between cereals and oil meals. Empty pea pods have been reported to contain 19.8% crude protein and 1.0% ether extract, rich in total soluble sugars (35.8%), total phenolics (9.4%) and macro and micro minerals. The digestion kinetic parameters for dry matter revealed that pea pods had 82.3 per cent degradable fractions and 68-69 per cent effective and true degradability. In India, total quantity of green pea pods available on annual basis accounts to 68.5×10^3 tones. Pea pods are relished by ruminants and are highly palatable with high nutritive value and an effective method of utilization of pea waste after removal of pea grains from pea pods as complete feed in ruminant animals.

Key words: Alternate feeds, Body condition score, Milk production, Nutrients intake, Pea pods residue, Total phenolics.

India is an agrarian country where a large population is practising farming as their prime occupation. Livestock give a substantial contribution in sustaining rural economy and livelihood and upliftment of socio-economic status of rural people. It contributes, nearly 4.11 per cent to total GDP and 25.6% of total agriculture GDP. Present livestock population of 535.78 million registered an increase of 4.6% over Livestock Census 2012. India has a population of over 300 million bovines as per the 2019 livestock census, including 192.49 million cattle and 109.85 million buffaloes. In 2019, the Indian dairy sector was reported to be growing at 4.9% yearly. In 2018-19, the Government of India reported that 187.7 million tonnes of milk had been produced and that the per capita availability of milk in India was 394 grams per day (DHAD-2020).

By 2050 the world will need to feed an additional 2 billion people and require 70 per cent more meat and milk. In India availability of feed stuffs both in quantitative and qualitative forms has been the major constraint for sustaining positive growth in Indian livestock sector. Latest estimate on demand-supply gap in fodder availability shows a net deficit of 30.65% green fodder and 11.85% dry crop residues in year 2020 (IGFRI Vision, 2050). Using agricultural waste such as green pea pods residue in animal feeding is an interesting way to reduce feed cost and environmental pollution. In order to bridge the estimated gap between availability and requirements of feed, new avenues are to be continuously explored and one such emerging category of by-products is green pea pods residue.

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Pea pods

The pea classified into Kingdom: Plantae, Order: Fabales, Family: Fabaceae/Leguminaceae, Genus: Pisum, Species: *Pisum sativum* L. Field pea (*Pisum sativum)* is a cool-season legume crop that is palatable and nutritious as seed and forage. The seed is an excellent source of protein (24.3%) (Lardy and Anderson, 2009) and energy (0.70 Mcal NEg per pound) (NRC, 2001) and other nutrients. The pea is the small spherical seeds of the pod fruit *Pisum sativum.* Each pod contains several pea seeds. Peas are starchy, but high in fiber, protein, vitamin A, vitamin B_6, vitamin C, vitamin K, phosphorus, magnesium, copper, iron, zinc and lutein. Pea seeds are regarded as a highly valuable protein source for nutrition due to their high protein content (about 22-24%) which is intermediate between cereals and oil meals (Castell *et al.,* 1996). Pea peels have good nutritional value and

hence value added feeds can be prepared by using pea peels. Pods are dehiscent and contain several seeds that may be globular or angled, smooth or wrinkled (FAO, 2011; Muehlbauer and Tullu, 1997).

Pea pods residue in animal nutrition

Empty pea pods have been reported to contain 19.8% crude protein and 1.0% ether extract, rich in total soluble sugars (35.8%), total phenolics (9.4%) and macro and micro minerals. The empty pea pods are rich in crude protein (19.8%), soluble sugars, phenolics and macro- and micro-elements. The digestion kinetic parameters for dry matter revealed that pea pods had 82.3 per cent degradable fractions and 68-69 per cent effective and true degradability. In India, total quantity of green pea pods available on annual basis accounts to 68.5×10^3 tones. Pea pods are relished by ruminants and are highly palatable with high nutritive value and an effective method of utilization of pea waste after removal of pea grains from pea pods as complete feed in ruminant animals (Wadhwa *et al.,* 2006).

Effect of pea pods residue feeding on nutrients intake and digestibility

Wenk and Zurcher (1990) found that soybean hulls and barley hulls proved to be very well suited for growing pigs (11.4 MJ DE/ kg DM and 10.0 MJ DE/ kg DM, respectively) However pea hulls showed a mean content of digestible energy (5.6 MJ DE/ kg DM), whereas the millet hulls (1.1 MJ DE/ kg DM) did not contribute significantly to the energy supply of the pigs. Gdala *et al*. (1992) analyzed for content of nutrients and some anti-nutritional factors in six varieties of white flowered and three varieties of coloured flowered peas and observed that colour flowered varieties of pea has significantly more NDF ($P<0.05$), lignin and tannins ($P<0.01$) than the white flowered peas whereas trypsin inhibitor activity ranged widely in both white and coloured flowered peas and methionine, cystine and threonine were negatively correlated with the protein content of the tested seeds and the true ileal and faecal digestibilities of pea protein ranged from 66 to 83% and from 74 to 88%, respectively in cannulated pigs. Corbett *et al*. (1995) concluded that peas can be substituted for soybean meal and canola meal as a protein source for high-producing dairy cows. Cows fed extruded peas had higher dry matter intake than those fed with soybean meal and no differences were observed between cows fed extruded and raw peas (Petit *et al*. 1997). Birkelo *et al*. (2000) reported that there were no differences between whole and rolled pea treatments for finishing diets in cattle and also dry matter intake did not differ between control and pea treatments from day 1 to 56, day 57 to 105 or overall. Khorasani *et al.* (2001) observed that substitution of peas for soybean meal (SBM) and barley at levels of 0%, 33%, 67% and 100% of the concentrate did not influence dry matter and crude protein intakes and also observed that substitution of SBM and barley grain with peas may alter the site and end-products of digestion. Ipharraguerre and Clark (2003) found that legume hulls can replace cereal grain to supply 30% of the dry matter in high-grain diets without negatively affecting the fermentation or digestion of nutrients in the gastrointestinal tract or the performance of dairy cows. The field peas can be used as an ingredient in creep feed to increase calf weight gain without negatively affecting ruminal fermentation and digestion (Gelvin *et al*. 2004). Moreover in beef steers treatments were field pea replacing corn at 0%, 33%, 67%, or 100% found that field pea is a highly digestible legume grain that ferments rapidly because of their relatively high level of protein, it will decrease the need for protein supplementation (Reed *et al.* 2004). Although in growing pigs fed South Dakota-grown field peas (*Pisum sativum* L.) observed that the nutrients in field peas were highly digestible and in diets for nursery pigs and growing- finishing pigs in amounts of at least 18 and 36%, respectively, without negatively affecting pigs performance (Stein *et al*. 2004). Collins *et al*. (2006) found that the *ileal* dry matter digestibility was significantly reduced in the transgenic peas compared with the non-transgenic peas *i.e*. 12.7% and 69.9%, respectively, which was largely due to reduced starch digestibility and apparent crude protein (CP) digestibility of the transgenic peas were found similar to the non-transgenic being 79.7% and 78.5%, respectively however amino acid digestibility of the transgenic and non-transgenic peas were also similar. Masoero *et al*. (2006) reported that when the pea (2.5 kg/cow/day) partially replaced the soybean meal and totally replaced the barley meal of the base diet, the unprocessed or differently processed pea did not affect the dry matter intake of dairy cows. The replacement of grass, silage with pea- barley silage had no effect on, apparent digestibility of diet organic matter and crude protein, however, digestibility of diet neutral detergent fibre decreased linearly ($P<0.01$) as the proportion of pea barley silage in the feeding increased (Pursiainen and Tuori 2006). There were no differences among treatments for dry matter intake or organic matter intake in pulse grains in receiving diets for cattle and no treatment effects for apparent ruminal and total tract OM digestibilities were found when pulse grains replaced corn and canola meal and also crude protein intake, microbial crude protein flow, total tract crude protein digestibility and microbial efficiency were also not influenced by treatment however, total-tract ADF and NDF digestibilities were greater with field pea as compared to control but total VFA concentrations were lower for field pea and lentil compared with control and also chickpea, field pea and lentil had lower acetate molar proportion than control observed by Gilbery *et al*. (2007). Soto Navarro *et al*. (2012) observed that the supplementation of field pea to gestating cows consuming medium-quality grass hay increased total dry matter intake. Although, the highest cow-calf net return was from the starch base with soyabean meal, fibre base with 20% pea and fibre base with 30% pea weaning transition diet treatments ($P<0.001$) as reported by Senturklu and Landblom (2015). Tusnio *et al*. (2017) observed that the animals fed the

extruded pea diet had a significantly better apparent protein digestibility than those fed with raw pea seeds.

Effect of pea pods residue feeding on growth performance

Birkelo *et al*. (2000) found that steers consuming the pea diets grew faster than control group in a 56 days feeding trial but slower from 57 to 105 days. As a result, overall daily gain did not differ among treatments. However, the replacement of soybean meal with peas did not significantly affect growth performance observed by Lanza *et al*. (2003). The field peas can be used as an ingredient in creep feed to increase calf weight gain was observed by Gelvin *et al*. (2004). As the amount of field pea hay (FPH) was increased *i.e*., 0% (T1), 0.5% (T2) and 0.3% (T3) of body weight of FPH on dry matter basis in the diet of Murrah buffaloes, the body weight increased was found by Hayashi *et al.* (2007). Newman *et al*. (2011) observed that the soybean meal in diets fed to growing-finishing pigs may be replaced by pea chips without negatively affecting growth performance of the animals. However, when the animals are fed with the grazing oat and pea crop residue, the performance was not negatively affected observed by Krause *et al*. (2013). The field pea can replace up to 20% of fiber-based ingredients in weaning transition diets without affecting average daily gain was found by Senturklu and Landblom (2015). Furthermore animals fed the extruded pea diet had a significantly greater average daily gain than those fed the soybean meal diet and also improved growth performance of pigs observed by Tusnio *et al*. (2017).

Effect of pea pods residue feeding on milk production

Valentine and Bartsch (1990) found that milk production was higher for early lactation cows fed peas than for those same cows fed barley. Mustafa *et al*. (2000) reported that pea silage can be used to replace barley silage without affecting milk yield or composition. However, the substitution of peas for soybean and barley, milk yield were not affected was observed by Khorasani *et al.* (2001). There was no negative effect on milk yield and composition of dairy cows when the diet of soybean meal was substituted with flaked peas and faba beans was found by Volpelli *et al*. (2012). Furthermore a part of extruded soybeans replacement with peas (*Pisum sativum*) in dairy cows rations had a negative effect on milk yield but increased milk fat and protein content and also during the experimental period, the amount of urea and lactose in milk, both in control and experimental groups, differed non-significantly (Kudlinskiene *et al*. 2016).

Effect of pea pods residue feeding on body condition score

The effect of feeding pea pods / pea pods residue on body condition score of animals. Poland *et al*. (2004) found that body condition score (BCS) change was improved by supplementation of field pea and sunflower meal as compared to control group on day 42 in year 1st and on day 84 in year 2nd. Parveen *et al*. (2009) reported that all the body measurements *i.e*. body length, chest girth, height at withers and paunch girth of Sahiwal calves of 1 month to 6 months of age showed increase in body dimensions of the calves with the growing age and the BCS is nonlinear, with an optimum calving BCS of 3.0 to 3.25 (5-point scale); lower calving BCS is associated with reduced production and reproduction, whereas calving BCS>3.5 (5-point scale) is associated with a reduction in early lactation dry matter intake and milk production and an increased risk of metabolic disorders reported by Roche *et al*. (2009). Klopcic *et al*. (2011) reported that first the farmer can use the score of the classifier as a reference for his body condition scores and second, the herd book could use the BCS to present trend in the herd in time, which can help the farmer to analyze his feed management. Therefore body condition score is a tool in selecting cows which balance production, fertility and health in the right way. However, the body condition score was higher in crossbred calves fed with high concentrate ration (containing 60% concentrate and 40% sorghum stover) as compared to the calves fed with low concentrate ration (40% concentrate and 60% sorgum stover) was found by Sunetha (2013). Furthermore, the body condition score of crossbred calves fed with low energy ration is lower than the calves fed with high energy ration was observed by Kumar (2015b).

Effect of pea pods residue feeding on haemato-biochemical constituents

Petit *et al*. (1997) reported that there was no difference in serum urea concentration between cows fed raw peas and those fed extruded peas. However, serum urea concentrations were higher for cows fed extruded peas than for those fed with soybean meal. Masoero *et al.* (2006) observed that there were no differences observed among feeding groups on blood parameters except for the cholesterol level which was higher (P<0.05) in animals fed the expanded pea diet. Pea's supplementation had no effects on metabolic blood profile as well as clotting aptitude and also found that the blood level in cows appeared to be decreased by the replacement of soybean with pea in concentrates and there is no significant difference occurred in blood metabolites, electrolytes, or enzymes between control soybean and experimental pea diets was found by Tufarelli *et al.* (2012). However, blood proteins values were comparable between the experimental groups, whereas a slight but significant increase of blood urea was observed in cows fed pea and faba beans as compared to cows fed with soybean meal was reported by Volpelli *et al*. (2012).

CONCLUSION

It could be concluded that utilization of pea pods is the beneficial in enhancing the growth performance, body condition score and also milk production of dairy animals. This is an effective method of utilization of pea waste after extraction of pea grains from pea pods.

Conflict of interest: None.

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