Extracted by-products from empty pea peels and their nutritional evaluation

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ABSTRACT : Pea processing industry involves preserving peas by freezing and marketing them for seasonal limitation and producing a very high amount of waste as a by-product. The waste generated from this industry is not very utilized as a valuable byproduct and considered as end products that have not been recycled or used for other purposes. In the present study, pea peels were further extracted and separated into extracted peel juice and extracted peel straw and these three byproducts were dried and converted into powder for performing proximate analysis. The result of nutrition evaluation revealed that among all three samples, pea peels have a higher value of EE (2.27%) and AIA (1.39%), the composition of extracted peel straw found to be higher in CF (2.29%) and Carbohydrate (81.06%), whereas extracted peel juice have higher quantity of CP (30.04%) and TA (7.87%). Therefore, the waste pea peels can be used as an alternative source of animal feed and serve as a better solution to the waste disposal problem by preserving this valuable biomass.

Key words: By-products, pea peel, pea processing, pea industry waste, proximate analysis.

Pea (*Pisum sativum* L.*)* is a cool-season crop and one of the most important legumes, grows either alone or in combination with small grains, in the temperate climatic regions and it has been widely consumed as a legume or vegetable throughout the world for satisfying the purpose of both human consumption and animal feeding. In India, 9219.60 tonnes per annum size of the frozen vegetable market, out of which 75 percent is covered by green peas only (Kumari, 2016). Hence, in the Indian agriculture economy, green pea occupies a significant place.

Peas are seasonal and perishable in nature and its availability is limited only to some part of the year, which creates the need for its preservation (Garg, *et al*., 2015). Pea processing industry is a type of agro-industry, in which green pea processed. With the invention of freezing, canning and cold storage, various pea processing industries make efforts to preserve and marketed them so that this crop became available year-round.

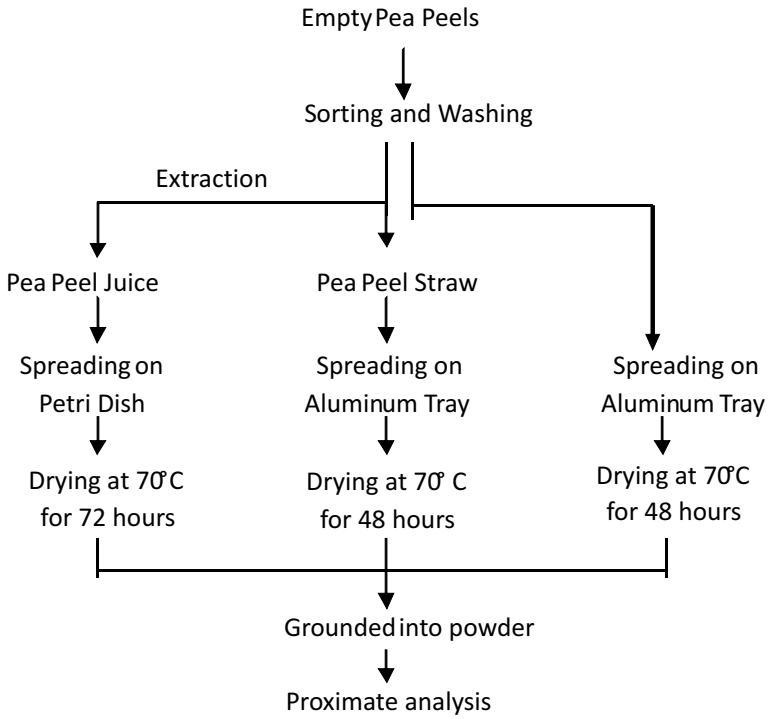
In the production process, after shelling of green pea, pea seeds were separated from pod. Pea seeds were then processed under the deep freezing condition and packed for marketing purpose so that pea becomes available during the off seasonal. During the process, the leftover material is empty pea pods or peels, which considered and discarded as waste. The huge amount of pea peel waste creating high disposal and pollution problems, which represents a loss of valuable nutrients. Beside their pollution and hazard aspects, this processing waste, without any quality degradation, might have a potential for conversion into useful products of higher value. This study was, therefore, taken up to assess the proximate analysis of pea peels and its extracted byproducts.

MATERIALS AND METHODS

Sample Collection: Fresh empty pea peels were collected pea processing industry and were sorted for further experiment.

Preparation of Extraction: The sorted pea peels were washed and weighed in a digital electronic balance. The grinding of selected peels was done with the help of electric grinder and mixture. It was observed that in 250 gm pea peels, extracted peel straw and peel juice weighed 90.5gms and 147.3gms. The extracted peel juice and peel straw were collected in separate jars.

Preparation of proximate analysis: For proximate analysis, all three samples were dried in a hot air oven and grounded in powder form. Weende's system of analysis (Henneburg and Stohmann) was used for estimation of proximate analysis of pea peels, extracted peel juice and extracted peel straw.



Moisture content (M) and Dry matter (DM):– Ten gram of each sample were taken in a pre-weighed petri dish/aluminum tray. The tray was placed in a hot air oven at 70 ± 2°C for 48 hours for pea peel and peel straw, 72 hours for peel juice. The drying was repeated until a constant weight was obtained. The loss in moisture content after drying was estimated and DM was calculated as follows:

$$\text{DM (\%)} = \frac{\text{Wt. of tray with dried sample - Wt. of empty tray}}{\text{Wt. of tray with fresh sample - Wt. of empty tray}} \times 100$$

Moisture content (%) = 100 dry matter (%)

Crude Protein (CP): The protein nitrogen in 1 gm of each dried samples were taken in Kjeldahl flask and digested with 20-30 ml concentrated H_2SO_4 and 2-3 g of digestion mixture till the solution became colorless. After digestion, the contents were cooled and the volume was made to 100 ml. 10ml of aliquot was distilled in Kjeldahl distillation apparatus after adding 10-15 ml of 40% NaOH solution. About 60-75 ml of distillate was collected into an Erlenmeyer flask containing 10 ml of 2% boric acid indicator solution. The distillate was then titrated against standard N/100 H_2SO_4 solution and the endpoint was recorded when the color changed to slightly pinkish. The volume of N/100 H_2SO_4 solution used in titration was recorded. Crude protein was calculated by multiplying the value of the deduced nitrogen by the factor 6.25mg.

$$\text{N (\%)} = \frac{0.00014 \times \text{Volume of N/100 } H_2SO_4 \text{ used} \times \text{Volume made (ml)}}{\text{Aliquot taken (ml)} \times \text{wt. of sample (g)}} \times 100$$

CP (%) = Nitrogen (%) X 6.25

Total Ash (TA): Two gram of each oven-dried sample were taken in a pre-weighed silica crucible. After charring the sample on the heater, the crucible was kept in a muffle furnace for ignition at 550°C for 2-3 h. The crucible was removed on cooling and kept in a desiccator and weighed again to find out the weight of the ash. The ash content was calculated as given below:

$$\text{TA (\%)} = \frac{\text{(Wt. of crucible along with ash after cooling - Wt. of empty crucible)}}{\text{(Wt. of crucible with ash before burning - Wt. of empty crucible)}} \times 100$$

Acid Insoluble Ash (AIA) **:** Five ml of conc. HCL added to the crucible containing the ash which was saved from the ash determination process. 20 ml distilled water was added and placed on 10°C hot plate, then evaporate the sample to about 10 ml and heated to around 90°C. After cooling, the sample was filtered in a 100ml flask. The filter paper with residue was removed carefully, put in the same crucible to dry out in hot air oven and ignite in muffle furnace at 55°C for 1 hour. After this crucible was kept in desiccator weighed.

$$\text{AIA (\%)} = \frac{\text{(Wt. of crucible with Ash Wt. of empty crucible)}}{\text{(Wt. of crucible before burning Wt. of empty crucible)}} \times 100$$

Ether extract (EE): Two gram of each sample was taken in a cellulose thimble and extracted for 6-8 hours with

petroleum ether in Soxhlet's extraction apparatus attached to a pre-weighed oil flask. The oil flask was removed and after evaporating the excess of ether, it was dried overnight in a hot air oven (100±2°C). The flask was cooled in a desiccator and weighed to a constant weight. The difference between the two weights gave the amount of ether extract in the sample.

$$\text{EE (\%)} = \frac{\text{(Wt. of oil flask with ether extract Wt. of empty oil flask}}{\text{Wt. of sample on dry basis}} \text{ X } 100$$

Crude Fibre (CF): The residue left after ether extract determination was used for CF estimation. Two gram of each sample was weighed into separate beakers and then extracted with petroleum ether about 8 hours. The samples were then air-dried and transferred into a dried 1litre capacity spoutless beaker. Two hundred ml of sulphuric acid solution (1.25%) was added into the beaker. The beaker was placed on preheated extraction heater and cover with round bottom flask having an arrangement for continuous circulation of running cold water and 25ml of 10% sulphuric acid (2.04N) was added, and then boiled for 30 minutes. The contents were filtered to remove insoluble materials, which was then washed with distilled water, then with 1.25% NaOH. Residue was then transferred to silica crucible and dried at 105°C in the oven for overnight. Finally, the oven-dried residue was ignited in a furnace at 550°C. The fiber contents were measured by the weight of the left after ignition and were expressed in term of the weight of the sample before ignition.

$$\text{CF (\%)} = \frac{\text{Loss of wt. on ignition}}{\text{Wt. of sample after drying in oven}} \text{ X } 100$$

Carbohydrate (CHO) by difference: Carbohydrate content was calculated by subtracting crude protein, extract ether and ash contents from 100 (Das *et al*., 2015).

CHO (%) = 100 – (CP% + EE% + TA%)

Physiological energy : The calorific value (Kcal/100g) of the sample was calculated by summing up the product of multiplication of percent crude protein, crude fat, and carbohydrate present in sample 4, 9 and 4 respectively.

Physiological energy value (Kcal/100g) = 4 X CP(%) + 9 X EE(%) + 4 X CHO(%)

RESULTS AND DISCUSSION

Table 1 shows the proximate analysis values of pea peel, peel extracted straw and peel extracted juice in mean and SD.

Proximate composition of pea peel: Nutrient composition of pea peel obtained by the proximate analysis shows that in empty pea peels the mean value of DM and moisture content were found to be 16.73±0.19 and 83.27±0.19 respectively. Whereas the mean composition of CP was found to be 19.80±1.65, EE was 2.27±0.61, TA was 5.65±0.33, CF was 1.84±0.011 and AIA was 1.39±0.035 in pea peels. In addition, the value of Carbohydrate and physiological energy were calculated as 72.7 percent and 380.79 Kcal/100g respectively. The values obtained from this study are similar to the data earlier reported by other researchers. Wadhwa *et al.* (2005) conducted a research and found the almost same value of crude protein in pea peels i.e. 20.5 percent, whereas Waller, (2010) in his study found similar fat content (1.1 %) in pea peels and Aparicio *et al.* (2010) in their study recorded the content of carbohydrate was 81.3 percent in empty pea peels.

Proximate composition of peel extracted straw: It was revealed from the analysis of peel extracted straw that the mean value of DM and Moisture content was found to be 30.93±0.01 and 69.05±0.01 respectively. Whereas the mean content of CP, EE, TA, CF, and AIA were found to

Table 1: Proximate composition of pea peel, extracted peel straw and extracted peel juice

S. No.	Parameters	Samples		
		Pea Peel	Peel Extracted Straw	Peel Extracted Juice
		Mean± S.D	Mean± S.D	Mean± S.D
1.	Dry Matter (%)	16.73±0.19	30.93±0.01	11.60±0.99
2.	Moisture (%)	83.27±0.19	69.05±0.01	88.4±0.99
3.	Crude Protein (%)	19.80±1.65	13.06±1.46	30.04±1.74
4.	Ether Extract (%)	2.27±0.61	1.11±0.13	0.81±0.01
5.	Total Ash (%)	5.65±0.33	4.77±0.41	7.87±0.40
6.	Crude Fibre (%)	1.84±0.011	2.29±0.085	-
7.	Acid Insoluble Ash (%)	1.39±0.035	1.31±0.42	0.282±0.11
8.	Carbohydrate (%)	72.28	81.06	61.28
9.	Physiological energy(Kcal/100g)	380.79	392.99	365.28

be 13.06±1.46, 1.11±0.13, 4.77±0.41, 2.29±0.085 and 1.31±0.42 respectively in peel extracted straw. Furthermore, the content of carbohydrate and physiological energy present in extracted peel straw were calculated as 81.06 percent and 392.99 kcal/100g respectively.

Proximate composition of extracted peel juice: Proximate composition of extracted peel juice obtained from the analysis was indicated that the mean content of DM was found to 11.60±0.99, moisture content was 88.4±0.99, CP was 30.04±1.74, EE was 0.81±0.01, TA was 7.87±0.40, and AIA was 0.282±0.11. The mean content of carbohydrate was found to be 61.28 percent and physiological energy was 365.28 kcal/100g. Whereas it was also observed from the analysis that the content of CF in extracted peel juice was found to be nil.

The result of one way ANOVA reveals that there was a significant difference between all three samples.

CONCLUSION

It can be concluded from the findings that the presence of high crude protein and other compounds in these three samples represent this waste as a valuable organic substance. Therefore, the waste pea peels and its extracted by-products can be used as a substitute to animals feed and making some other value-added product for human consumption. It is not only a promising solution for zero waste management but it leads to sustainable environment.

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