

Value Added Products from Apple Pomace

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Apple pomace dumped outside factory

Apple pomace is a major global waste product generated primarily during apple juice processing and represents up to 30% of the original fruit. This solid residue consists of a complex mixture of peel, core, seed, calyx, stem, and soft tissues. In India, about 5,000

tonnes of apple pomace is produced annually from different apple processing industries, and usually dumped outside the factories, wherein it ferments and causes air pollution. Sometimes, it is disposed off in the running *nallas* or rivers that cause severe water pollution. In different parts of the world, only 25%-30% of apple pomace is used for the development of fertilizer, fuel, feedstuff, ethanol, vinegar or some industrial materials, and rest usually goes as waste. However, in India, it is not at all utilized and merely goes waste because little efforts have been made on its utilization. In fact apple pomace is a rich source of several vital constituents, which should be effectively utilized (Table 1). Hence, underutilization of such an useful commodity poses serious threat to environmental pollution with huge economic loss. Thus, more and more people have been focusing on the full utilization of apple pomace. Several methods have been



developed in different countries to solve this problem, and as result of these methods, technologies have been standardized to produce pectin, ethanol, lactic acid, citric acid, enzyme etc., with apple pomace as raw material. Thus, there is urgent need to find ways and means for effective utilization of apple pomace in India and it is desirable to think about the development of higher value added products from apple pomace, which could be economically worthwhile for commercial exploitation. Now several technologies have been developed for effective utilization of apple pomace for the development of edible, fermented, industrial and some miscellaneous products.

Table 1. Proximate composition of apple pomace

Total ash (per cent)	1.65	Moisture content (%)	76.79 per cent
Crude protein (per cent)	3.99	Nitrogen free extract (%)	76.41
Crude fibre (per cent)	16.16	Total sugar (%)	17.35
Phosphorous (rng/100 g)	113	Pectin (%)	16.95
Iron (mg/100 g)	70	Acidity (per cent)	2.39
Calcium oxide (mg/100 g)	123		

A. Edible Products

Several value added products such as jam, jelly, sauce, cookies etc., can be prepared from apple pomace for human consumption. However, collection of apple pomace under strict hygienic condition is absolutely necessary for safety of the products.

Jam and jelly

Apple pomace can successfully be converted into jam of acceptable quality. For the preparation of pulp required for jam, 1:3 dilution of apple pomace is optimum, and 1:1.25 is the best pulp:sugar ratio. Jam so prepared has a storage life of 6 months. ttempts have also been made to prepare jelly from apple pomace. For this, apple fruit slices and pomace should be boiled with water in a 1:1 ratio for 25 and 35 min, respectively and juice concentrate be diluted up to 15.0° Brix.

Jelly so prepared has desirable characteristics for wider



Apple jam

acceptability.

Pomace sauce

A sauce of acceptable quality can be prepared from apple pomace by mixing pulp and sugar in the ratio of 1:0.1:2. Sauce so prepared has a storage life of 6 months with acceptable psycho-chemical and sensory qualities.

Soft drinks

Soft drinks have also been prepared from apple pomace. For this, apple pomace extract should either be blended with apple juice or sugar and its TSS be raised to 12°Brix and acidity to 0.30-0.40 per cent. The blended juice after filtration, carbonation and pasteurization has an acceptable sensory qualities.

Cookies, biscuits and bread

Fresh apple pomace without cores, twigs and coarse outer skin, after drying to 5 per cent moisture and pulverization to a 'finger fine feel' powder can be used in place some portion of white refined flour to prepare cookies. Thus, biscuits prepared had appearance and flavour similar to those prepared with addition of chocolate flavor. Apple pomace can be incorporated in the bread up to 5 per cent without changing the quality of bread drastically. Apple pomace has also been utilized to prepare *papad*.

B. Fermented products

Several fermented products such as cider, vermouth, vinegar, beer have also been prepared from apple pomace.



Apple cider

Cider

Cider is an important alcoholic drink prepared from apples. However, technologies have been standardized to prepare it from apple pomace as well. For this, TSS of the extract containing hot water extract of apple pomace, sugar, acid and colour is raised from 4 to 12° Brix by adding sugar and preferably citric acid



along with sulphur dioxide, is fermented into an acceptable low alcoholic product (3-5 per cent). Other steps in the preparation of cider including fermentation, racking, clarification etc. are similar to cider preparation. Further improvement can be made by carbonating the drink. Preparation of cider by combining distillate from fermented apple pomace with fermented apple juice has also been attempted.

Beer

It is similar to cider prepared from apple fruits. The method of preparation is also same as outlined earlier, except that hops extract is added to the fermenting liquor. Organoleptically, the beer prepared from apple pomace has good acceptability.

Dried apple pomace, a source of several value added products

Vinegar

Vinegar can also be prepared from the pomace extract by the 2-stage method of alcoholic and acetic acid fermentation. The process is similar to that described earlier for cider vinegar. The acetic acid fermentation is brought out by acetic acid bacteria *Acetobacter* spp. After this, the liquid is allowed to age to improve the flavour, wherein acetic acid may react with alcohol to produce ethyl acetate giving fruity flavour to the vinegar. The finished product is bottled and pasteurized at 85°C for 20 min. The product has very pleasant fruity flavour and acceptability.

C. Industrial Products

Technologies have been standardized for the development of several industrial products like pectin, charcoal, pigments and animal feed etc.

Flavour compounds

Apple pomace can be used to produce natural flavouring compounds by extracting with liquid CO₂ which is then, fractionated at different temperatures obtaining flavourless fraction and intensely flavoured fraction. Flavour compounds extracted by this method had broader flavour spectrum than those obtained by distillation.



Citric acid extracted from pomace

Pectin

Pectin, an essential additive in jelly preparation, can be obtained from the apple processing wastes. Dried apple pomace is used for pectin extraction. The pomace is sun or mechanically dried to a moisture level of 12 per cent, which is then boiled in water for half an hr. Protopectin is hydrolyzed to pectin by heating and acid hydrolysis. The pectin is extracted by alcohol precipitation. Extraction of pectin by microbial process, using *Trichosporon penicilliatum* has successfully been developed for citrus, if applied, for apple pomace may prove technically and economically feasible. Another innovative approach in pomace utilization is the precipitation of pectin under acidic conditions and use of liquid phase for microbial growth.



Apple pectin

Citric acid

Citrus acid of commercial value can be prepared from apple pomace by utilizing *Aspergillus niger*. Citric acid so prepared has wider acceptability and commercial value.



Pomace, a waste of apple processing factories



Core and seeds, a waste of apple processing factories

Ethanol

Production of ethanol is one of the most valuable products prepared from apple pomace. Ethanol prepared from apple pomace has potable and industrial application. Solid state fermentation process is utilized in the production of ethanol from apple pomace and usually *Saccharomyces cerevisiae* is principally employed as fermenting microbe.

Animal feed

Fresh or dried apple pomace can be used for making animal feed. Fresh apple pomace has

successfully been used in appropriate quantities for feeding milching cows in combination with other fodders. Fermentation has also been employed as a potent tool to produce animal feed from fruit processing wastes including apple pomace. and *Trichoderma fabsei* for its use as a cattle feed.

Industrial pigments

In several countries, apple pomace is used for the production of carotenoid pigment by using a strain of *Rhodotorula*. The only addition made to the pomace is ferrous ammonium sulphate and agar. Incubation should be done at 30°C for 72 h. This medium is quite cheaper than the conventional liquid medium recommended for



Carotenoids, extracted from apple pomace

pigment production.

Charcoal

Apple pomace can be converted into charcoal briquets. The briquets have been prepared by heating the dried apple pomace at 160-200°C followed by grinding the pyrolyzate to pass a 40 mesh sieve and moulding the particles. Another use for apple pomace charcoal is for water purification, which is being used commercially.

Miscellaneous products

Apple pomace can also be utilized for the development of baby foods, apple cookies, and apple cereal flakes.

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