

## Enjoying value-added products of apple pomace

The apple pomace is a waste generated by apple juice processing industries, which is usually dumped outside factories or in running water where it acts as a major source of pollution in water and air. In India, about 5,000 tonnes of apple pomace is produced, which merely goes waste, whereas it is a good source of several vital elements. The technologies have been standardized world over for its effective utilization for the development of several value-added products like jam and jelly, pectin, ethanol, citric acid, vinegar and animal feed. Thus, we can save our environment and huge foreign exchange, which our country spends on importing such products from several countries.

APPLE pomace is a major global waste product generated primarily in its juice processing, which is to 30% of the 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 its processing industries. Sometimes, it is disposed off in running *nallas* or rivers that cause severe water pollution. Only 25-30% of apple pomace is used for the development of fertilizers, fuel, feedstuff, ethanol, vinegar and other industrial materials. However, in India, it is not at all utilized and merely goes waste.

In fact, apple pomace is a rich source of several vital constituents, which should be effectively utilized (Table 1). 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 more value-added products.

Table 1. Proximate composition of apple pomace

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



Royal delicious apples

### EDIBLE 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 best pulp:sugar ratio. Jam so prepared has a storage life of 6 months. Attempts 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 acceptability.



Apple jam

#### Pomace Sauce

A sauce of acceptable quality can be prepared from apple pomace by mixing pulp and sugar in the ratio of





Pomace, a waste of apple processing factories



Core and seeds, a waste of apple processing factories

1:0.12. Sauce so prepared has a storage life of 6 months with acceptable physico-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%. The blended juice after filtration, carbonation and pasteurization has acceptable sensory qualities.



Dried apple pomace, a source of several value added products

### Cookies, Biscuits and Bread

Fresh apple pomace without cores, twigs and coarse outer skin, after drying to 5% 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% without changing the quality of bread drastically. Apple pomace has also been utilized to prepare *papad*.



Citric acid extracted from pomace

### Fermented Products

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

### 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%). Other steps in the proportion 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.

### Vinegar

Vinegar can also be prepared from pomace extract by 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 minutes. The product has very pleasant fruity flavour and acceptability.

### Industrial Products

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



Carotenoids, extracted from apple pomace

### Flavour Compounds

Apple pomace can be used to produce natural flavouring compounds by extracting with liquid CO<sub>2</sub> 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.

### 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%, which is then boiled in water for 0.5 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.

### 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.

### 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 hours. This medium is quite cheaper than the conventional liquid medium recommended for 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.

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