INCORPORATION OF DRIED APPLE POMACE PULP POWDER IN BREAD
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ABSTRACT
Apple pomace pulp powder of different juice recoveries was incorporated in refined flour as a source of dietary fibre for preparation of bread. The level of incorporation was standardized to the ratio of 70:30 (flour: pomace). Apple pulp powder was taken for comparison between pomace powders. A control treatment (refined flour alone) was also run. Addition of pomace decreased the loaf volume of bread. It also affected the colour of bread loaf giving brown to dark brown colour. The crumb colour of treated breads was brownish cream. The breads were less soft in texture and were having slightly coarse grains. The control loaf was light brown in colour and was having creamish colour crumbs with soft texture and fine grains.

INTRODUCTION
Apple is one of the important fruit crops known to mankind and is produced all over the world in the temperate climate (FAO, 1989). In India, it is grown mainly in the northern states including Himachal Pradesh and Jammu and Kashmir where large scale apple processing plants are located (Shah and Masoodi, 1994). Most of the production of the fruit is used for table purpose but a portion is being processed into various products of which apple juice is processed to a greater extent. Apple pomace is a primary by-product of the apple juice industry. It has been estimated that about 25 per cent of the fresh fruit is lost as pomace (Wang and Thomas, 1989). This apple pomace deposits as a colossal waste causing disposable problems due to its wet easily fermentable form. So, safe disposal of this processing waste is very important to prevent environmental pollution. Mostly, this waste is used as animal feed. For food purpose, the pomace is mainly being used for extraction of pectin and alcohol and some other products (Jain et. al., 1984, Hang, 1987). Being a rich source of carbohydrate, pectin, crude fibre and minerals, it is a good source of nutrition. The composition of apple pomace with respect to its fibre content viz sugar, cellulose, hemi-cellulose, pectin and roughage appears to have the best proposition for incorporation in the bakery industry for production of high fibre baked foods. The crude fibre content of apple pomace is approximately 14-30 per cent of the dry weight. Apple fibre is higher in TDF (Total Dietary Fibre) than wheat and oat bran. It has good water holding capacity and act as humectant in certain food products (Chen et al. 1988). Apple fibre has been incorporated into cookies, granola bars and muffins to produce high fibre bakery products (Deuel. 1986).

Utilisation of dried apple pomace therefore holds a significant promise in improving nutritional quality in general and fibre content of baked products in particular to a greater extent (Morris, 1985). The present investigation was therefore carried out to incorporate dried and powdered apple pomace pulp into bread as a source of potential dietary fibre and to study the effect of incorporation on its physical and sensory characteristics.

MATERIAL AND METHODS
The level of incorporation was standardized by using refined flour and pomace pulp powder in the ratio of 80:20, 70:30 and 60:40. Sensory analysis carried out for best recipe of product showed that ratio of 70:30 was preferred as compared to the rest lots and
Studies on incorporation of pomace pulp powder as a source of dietary fibre in bread were carried out. Crude fibre content found in Tl, T2, and T3 powders was 7.66, 19.66 and 12.98 per cent respectively. No particular effect of different treatments was seen on dough characteristics of breads (Table 1). Dough was found to be non-sticky in T0, T1, and T2 treatments whereas that of T3 are found to be on slightly sticky side. Along with this, the values for water absorption capacity and loaf weight were found to be more for the treated samples than control. The increased water absorption may be caused by the strong water-binding ability of fibres and the increased loaf weight was caused by high water retention. The main effect was seen on loaf volume. Loaf volume was more for T0 treatment (325 cc) which had refined flour alone without any pomace powder addition. There was a slight decrease in loaf volume when dried pomace powder was added. The loaf volume of T1 treatment was found to be 322 cc while that of T2 and T3 was 310 cc respectively. The dry and crisp pomace powder hindered the

**RESULTS AND DISCUSSION**

Studies on incorporation of pomace pulp powder as a source of dietary fibre in bread were carried out. Crude fibre content found in T1, T2, and T3 powders was 7.66, 19.66 and 12.98 per cent respectively. No particular effect of different treatments was seen on dough characteristics of breads (Table 1). Dough was found to be non-sticky in T0, T1, and T2 treatments whereas that of T3 are found to be on slightly sticky side. Along with this, the values for water absorption capacity and loaf weight were found to be more for the treated samples than control. The increased water absorption may be caused by the strong water-binding ability of fibres and the increased loaf weight was caused by high water retention. The main effect was seen on loaf volume. Loaf volume was more for T0 treatment (325 cc) which had refined flour alone without any pomace powder addition. There was a slight decrease in loaf volume when dried pomace powder was added. The loaf volume of T1 treatment was found to be 322 cc while that of T2 and T3 was 310 cc respectively. The dry and crisp pomace powder hindered the

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**TABLE 1** Dough characteristics of bread.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Dough handling</th>
<th>Water absorption (ml)</th>
<th>Loaf weight (g)</th>
<th>Loaf volume (cc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>Non-sticky</td>
<td>61</td>
<td>120.18</td>
<td>325</td>
</tr>
<tr>
<td>T1</td>
<td>Non-sticky</td>
<td>62</td>
<td>120.23</td>
<td>322</td>
</tr>
<tr>
<td>T2</td>
<td>Slightly sticky</td>
<td>62</td>
<td>120.00</td>
<td>310</td>
</tr>
<tr>
<td>T3</td>
<td>Non-sticky</td>
<td>62</td>
<td>120.30</td>
<td>310</td>
</tr>
</tbody>
</table>

**TABLE 2** Physical characteristics of bread.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Colour</th>
<th>Shape</th>
<th>Colour</th>
<th>Shredding</th>
<th>Colour</th>
<th>Crumb Texture</th>
<th>Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>Light brown</td>
<td>Symmetrical</td>
<td>Light brown</td>
<td>No Creamish</td>
<td>Soft</td>
<td>Fine</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Brown</td>
<td>Symmetrical</td>
<td>Brown</td>
<td>No Brownish cream</td>
<td>Less soft</td>
<td>Slightly coarse</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>Dark brown</td>
<td>A-Symmetric</td>
<td>Brown</td>
<td>No Brownish cream</td>
<td>Less soft</td>
<td>Slightly coarse</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>Brown</td>
<td>Symmetrical</td>
<td>Brown</td>
<td>No Brownish cream</td>
<td>Less soft</td>
<td>Slightly coarse</td>
<td></td>
</tr>
</tbody>
</table>
Whole apples

Cleaning and Washing

Churning in fruit mill → Juice

Pomace

Addition of water to pomace (ratio 1:2)

Heating pomace to separate adhered pulp

Separated pomace pulp by passing through stainless steel sieve of 20 mesh

Pomace pulp

*Figure 1* Flow sheet for the extraction of pomace pulp

Pomace/apple pulp

Traying

Drying at 55-60°C for 10-12 hours to a moisture content of 15 per cent

Scraping the dried mats and further drying to a moisture content of 5 per cent

Grinding

Packing

*Figure 2* Flow sheet for preparation of pulp powder
Figure 3 Flow sheet for preparation of bread

Refined flour + pomace powder

Sugar → Salt

Sieve

Shortening → yeast

Water

Knead

Ferment (2 hours, 30 minutes)

Remix (25 seconds)

Recover (25 minutes)

Sheeting

Molding

Proofing (55 minutes)

Baking (450°F for 30 minutes)
expansion capacity of the dough. It could also result from the interaction between gluten and fibre material or due to the dilution of gluten (Pomeranz et al. 1977). Chen et al. (1988)
observed in their bread baking experiments that as the concentration of fibre material increased, the water absorption mixing time and loaf weight increased and the loaf volume decreased. They found that in the bread baked with dried fibres, addition of 4, 8 and 12 per cent apple fibre to bread decreased the loaf volume by 17, 38 and 57 per cent respectively.

The main effect of the addition of pomace powders was seen on the physical characteristics of bread. Loaf of T2 treatment was little A-symmetrical and was dark brown in colour (Table 2). T1 and T3 loaves were brown and symmetrical while T0 was light brown. There was no shredding of the crust in either of the treatments. The colour of the crust was found to be light brown for T0 and brown for rest of the treatments. Regarding crumb characteristics, T1, T2 and T3 treatments had brownish cream crumb colour whose texture was less soft and grains slightly coarse. T0 had creamish crumb colour with soft texture and fine grains. Organoleptic evaluation was carried out for different sensory attributes, viz. colour, taste and overall acceptability (Fig. 4). The taste panelists preferred T0 for all attributes because of its appealing colour and fine texture. But, the rest of the treatments also scored on the “Good” side for all sensory qualities. In contrast, Wang and Thomas (1989) reported that the overall preference of muffins made by incorporating apple pomace was significantly more desirable than control. Beereboom (1979) reported that in most foods, the apple fiber has a poor flavour and also causes loss of appearance, texture and mouth feel noted by the consumers.
The results demonstrated the value of using apple pomace pulp powder directly in bread without affecting its quality. The high dietary fiber could provide consumers with an alternative source of fiber. In addition, its utilisation will provide a saving to the juice processor through both the sale of pomace and the elimination of disposal costs.

REFERENCES