Chapter 02
Literature Review

In a research paper “Time, food shopping and food preparation: some attitudinal linkages”\(^1\) the author discusses that time is a multidimensional entity and research into how we allocate our time is still at an early stage of development. Food shopping and meal preparation are two related activities which involve a significant consumption of time. Reports on research into attitudes to time and investigates three different aspects of people's attitudes towards food shopping and preparation: an enjoyment of cooking; and a traditional orientation and a modern (role-sharing) attitude to the linked activities. The research identifies two clearly defined groups. There are no differences between the groups existed on demographic factors such as age, gender, whether the respondent had paid work and housing type. No differences existed in their ownership of time-saving consumer durables. One group clearly saw mealtimes as significant activities and found cooking enjoyable. It did not matter whether the people in this group were time-pressured or not - they chose to allocate time to these activities and they differed in their attitudes to time. The research finds that a substantial group in society still does see food shopping and meal preparation as important activities. It contends that while such individuals may be subject to modern-day pressures they still appear to organize their time to maintain a traditional perspective.

In another research paper “Consumer perception of the nature and quality of home-made and commercial dairy ice cream”\(^2\) the authors describe that an important consumer opinion of some food products relates to the perception of “home-made quality”. This study examined consumer perception of this aspect in dairy ice cream along with product knowledge and consumption habits and influences. A questionnaire was delivered followed by tasting of commercial products and home-made formulations. All of the participants (n = 105) consumed dairy ice cream and 62 per cent named it as their most frequent type of ice cream, with sensory quality being the most important reason influencing choice. Product knowledge was relatively high with 74 per cent of

respondents claiming to know two out of three product characteristics. Consumer opinion was divided on a pre-stated preference for “home-made” or “commercial”, with 56 per cent being in favor of the home-made form, which was valued because of an assumed superior taste, quality and a more intimate knowledge of ingredients. Commercial quality also required “good taste”, but its convenience value was very important. On blind tasting, the degree of liking for both forms was usually high, but correct identification (home-made vs. commercial) levels were low. Subjects with previous experience of home-made ice cream had a more positive attitude to it, and had more success in distinguishing it from the commercial form. Generally, home-made quality was viewed as a desirable feature of dairy ice cream.

2.1 Global Scenario: Fruits, Vegetables & Spices

For the last five years the fruits production has been growing at a CAGR of 3% while the production of vegetables has been decreasing at a CAGR of 14%. India is the largest producer of fruits in the world, with a production estimate of 39 million MT (13% of the total world fruit production), while China (11%) and Brazil (10%) occupy the second and third rank respectively.

India also occupies the number one position in the production of banana (15% of the global banana production) and mango (59% of the global mango production). China is the second largest producer of mangoes and also for apples. Brazil is the leader in orange and papaya production, individually. Mexico is the largest producer of limes and lemons and ranks third in production of mangoes.

India is the second largest producer of vegetables in the world, after China, which has production of nearly 70 million MT. China (28%); India (19%) and USA (14%) are the top ranking countries in the world production of vegetables. China is also the leader in the production of Brinjal, Onion, Tomatoes, and Cabbages individually, while India ranks second in the production of Cabbages and Onion individually. USA ranks the third in the

---

production of Tomato, Onions and Potatoes, individually.

Global production of spices is about 7-8 million MT. India's share of global production is about 35%. Figure 2.1 presents the major chili, cumin, garlic and fennel growing countries of the world. As given in Figure 2.1 the main growing countries for the following spices are:

Chili: India, Chile, China, Egypt, Indonesia, Mexico and Sri Lanka

Cumin: India, Chile, China, Egypt, Mexico and Pakistan

Fennel: India, Argentina, China and Portugal

Garlic: India, China and Pakistan

Figure 2.1

Major Spices Growing Countries of the World
The global trade of spices is estimated to be about 500,000 MT valued at Rs. 60 bn per annum. India commands a share of about 47% of this trade in terms of quantity and 26% in terms of value.

The authors in a research paper 'familiarity and purchasing intention of Belgian consumers for fresh and processed tropical fruit products' notes that familiarity with tropical fruits differs and depends on consumers' product-related experiences. Tropical fruits are perceived as nutritious, healthy, good in taste, attractive and special. Socio-demographic characteristics, such as gender, place of living and travel experience outside Europe, associate with product familiarity, consumers' general attitude and beliefs, and the purchasing intention of tropical fruits.

2.2 Indian Scenario - Fruits

The research paper on 'antecedents to new food product purchasing behavior among innovator groups in India' notes the findings as follows.

"Through structural equation modeling, Fishbein and Ajzen's modified theory of reasoned action model (TORA) is used to study the impact of innovation on Indian consumers' purchase behavior of new processed foods. The results indicate that subjective norms are a key factor in understanding Indian consumers' new food purchase decisions regardless of their level of innovation. Specifically, subjective norms are found to have direct effects on attitudes, intention to buy, and purchase behavior for new processed food products. Surprisingly, attitudes have little effect on less innovative consumers' intention to buy. Additionally, product familiarity had a significant impact on Indian consumers' attitudes, subjective norms, intention to buy, and, ultimately, purchase behavior of the low innovator and high innovator groups."

Due to varied climatic conditions, India is at an advantage and can produce all types of fruits (tropical, sub-tropical and temperate).

---

Production - By States: The eight states, viz. Bihar (15%), Andhra Pradesh (13%), Tamilnadu (11%), Maharashtra (11%), Karnataka (11.3%), Uttar Pradesh (8.4%), Gujarat (5%) and Kerala (4.3%), together account for 80% of the total fruit production of India. Gujarat ranks 7th among the different states of India in fruit production. Banana, Mango, Papaya, Chiku, and Guava are the main fruits grown in Gujarat.

Production - By Fruits: India’s climate and soil conditions are conducive to grow most of the fruits. The nine fruits viz., Apple, Banana, Orange, Mosambi, Grapes, Litchi, Mango, Pineapple, and Chiku are the most commonly grown fruits in India and account nearly 98% of the total fruit production in India. As mentioned earlier, India is the largest producer of banana and mango. Banana (31%) and mango (26%) roughly account for 57% of the total Indian fruit production.

2.3 Indian Scenario – Vegetables

Production - By State: Nine states viz. Uttar Pradesh (19%), Bihar (18%), Orissa (12%), Karnataka (8%), Tamilnadu (6.25%), Maharashtra (4.20%), Kerala (3.9%), Assam (3.5%), and Andhra Pradesh (3.4%), together account for around 75% of the total vegetable production in India. Potato, Onion, Brinjal and Tomato are the main vegetables grown in Gujarat.

Production - By Vegetables: India’s climate and soil conditions are conducive to grow most of the vegetables. Brinjal, Cabbage, Cauliflower, Okra, Onion, Peas, Potato, and Tomato are the most commonly grown vegetables in India and account for nearly 77% of the total vegetable production in India.

2.4 Indian Scenario: Spices

Domestic consumption of spices is broadly estimated at between Rs.8,000 crores to Rs. 10,000 crores making it one of the largest commodity markets in India.

The 8 main spices viz. chili, turmeric, garlic, ginger, coriander, cumin, fenugreek and pepper account for about 94% of the total spice production in India. Out of these 8 main spices, Gujarat
produces chili, cumin and garlic in large quantities along with fennel. These four spices account for more than 80% of the total spice production in Gujarat.

Gujarat, a major industrial state, also has great potential to develop a vibrant agrarian economy through agro-industrialization by deriving competitive advantages from Gujarat's unique position in many commodities.

2.5 Gujarat Agriculture: Overview

In the research paper 'the impact of social values on food-related attitudes' the authors state that social values represent desired end states of being or desirable behaviors such as self-respect, warm relations with others, or excitement. These abstract social cognitions help shape product attitudes and through them guide overt behavior. Empirical research has supported this theoretical structure of values-attitudes-behavior, but only for a relatively few high involvement products. A sample of 323 adult women shoppers rated the importance of the nine social values from the list of values; reported their attitudes towards snack foods, convenience foods, and cooking; and described purchase frequencies for a variety of foods. The shoppers' food attitudes were consistently associated with self-reported food purchases. Moreover, ratings of several values were associated with attitudes towards snack foods and use of convenience foods, suggesting that social values may influence buyer behavior for low as well as high involvement products.

Gujarat state has the total area of 196 lakhs hectares of which about 55% land is cultivable. Major commercial crops grown in Gujarat are oilseeds, cotton, isabgul, guar, spices, fruits and vegetables. Food grains are the major part of Gujarat agriculture accounting for about 40% of total cultivable area. Gujarat has clear competitive advantage both in production and productivity in commodities like castor, fennel, cotton, groundnut, sesame, chikus, onion, banana, isabgul, guarseed and cumin. Apart from this, it has potential to develop competitive advantage in select fruits & vegetables (mango, potato, papaya and guava) and select spices (turmeric & garlic). However, in cereals like rice and wheat, vegetables (okra, brinjal, tomato) and some important spices (ginger and chili); Gujarat needs to upgrade its position especially with respect to productivity.

---

World trade in agriculture is one of the most heated and politically sensitive issues at WTO (World Trade Organization) meetings. Apart from an Agreement on Agriculture, other clauses which have a direct bearing on the Indian Agriculture are:

- Sanitary & Phyto-Sanitary (SPS) measures
- Agreement on Technical Barriers to Trade (TBT)
- Trade Related Intellectual Property Rights (TRIPS)

A brief analysis of WTO agreements shows that it will not have any major adverse effects on Indian and Gujarat agriculture in near future. However, unless the quality and infrastructural issues are taken care of, India (and Gujarat) will not be able to take advantages from improved terms of trade due to subsidy reduction and opening of world markets.

Despite much strength, Gujarat faces problems of inadequate irrigation, fragmented processing industry and commodity dominated exports. These problems can be overcome by developing irrigation infrastructure, consolidating and building agro-industries engaged in manufacturing of value added products. Gujarat has a tremendous potential to develop agro-industry economy in the next millennium. For this, Gujarat has to focus on few crops where sustained competitive competencies exist (or can be built), be a technology upgradation leader in these commodities (across the value chain), focus on value added products and focus on global integration.

2.5.1 Fruits and Vegetables

India was the largest fruit producer and the second largest producer of vegetables in the world. Fruit production has grown at 3% per annum whereas vegetable production decreased by a 14% per annum in last 5 years. The main F&V (fruits & vegetables) exporting countries are USA, Belgium and China while the UK, Germany, and Belgium are the main importing countries. Although, the world exports in F&V are more than 104 mn MT per annum. India's share in this is a mere 1%.

Due to varied climatic conditions, India is at an advantage and can produce all types of fruit and vegetables (tropical, sub-tropical and temperate). India is the largest producer of Banana (15% of world production) and Mango (59% of the total mango production). Gujarat stands at 8th position (5%, 1.9 mn MT) in fruit production in India. Major fruits grown are Banana...
(3rd largest, highest yield 36 MT/ Ha), Chikku (2nd largest in production and productivity), Mango, Papaya and Guava. The main vegetables grown in Gujarat are Potato, Onion, Brinjal and Tomato which together accounts for about 77% of total Gujarat vegetable production. In fact, Gujarat is the best producer (w.r.t. yield) of Potato and Onion.

Gujarat offers tremendous potential for the promotion of food processing and support services. It has been estimated that about 40% of horticulture wastages account from the post harvest losses. There is significant potential for investing in food and horticulture processing. The potential areas identified for investment are:

- Primary activities like grading, sorting, packaging, etc. which will add value to the horticulture produce in terms of quality assessment, ease of future handling and logistics.
- Secondary activities like dehydration and processing units will enhance the value of the product, in terms of the change of form and preservation.
- A Food-Park concept where an integrated network of multi purpose, multi-user warehouses, adequate transport facilities, horticulture clinic, grading and packing centre can be created to help F&V sector going up in the value chain

2.5.2 Spices

Spices are widely used all over the world as food flavoring ingredients as well as treating variety of ailments. The market for spices is classified into straight spices and value-added spices. Straight spices are spices in their natural form while value-added spices consist of masalas, oils and oleoresins of spices. The global production of spices is about 8 mn MT, out of which India's share is 35%. The main spice growing countries are India, China, Pakistan, Sri Lanka, Chile, Egypt, Mexico etc. The global trade of spices is estimated to be about 0.5 mn MT valued at Rs. 60 bn. India's share of global trade is 47% and 26% by volume and value respectively.

The 8 main spices viz. chili, turmeric, garlic, ginger, coriander, cumin, fenugreek and pepper account for about 94% of the total spice production in India. The share of straight and value-added spices in the exports by value is 63.9% and 36.1% respectively. The average price realization on value added spices (Rs 100,000/MT) is double that of straight spices (Rs 50,000/MT). Amongst the value-added spices, chili oleoresin, capsicum oleoresin, de-hydrated garlic flakes, de-hydrated
garlic powder and cumin oleoresins are showing potential for exports. The major markets for Indian spices by value were USA (30.2%), UK (6.3%), Japan (5.3%), UAE (4.8%) and Germany (4.7%).

The total production of spices in Gujarat was around 302,000 MT cultivated over an area of around 227,000 hectares. Chilies (~7%), cumin (~19%), fennel (~11%) and garlic (~44%) are the major spices grown in Gujarat and together have a share of about 81% of the spices production in Gujarat. The rank of Gujarat vis-à-vis other states in productivity, area and production of the main spices is as follows.

- Chilies: 4, 10 & 8 respectively. Gujarat needs to upgrade its position with respect to chili cultivation and production.
- Cumin: 1, 2 & 2 respectively. The state maintains the same rank vis-à-vis the world also. Gujarat has a clear competitive advantage in cumin cultivation and production.
- Fennel: No. 1 in all three. The state maintains the same rank vis-à-vis the world also. Gujarat has a clear competitive advantage in fennel cultivation and production.
- Garlic: 4, 2 & 2 respectively. Gujarat need to improve its garlic productivity (yield) by which Gujarat can gain competitive advantage in garlic production.

Spices produced by the farmer are brought to the APMC by the farmer or the village trader/broker. The spices are auctioned in the APMC to the buyers such as wholesalers, exporters and processors. The main problem faced by the spice industry in Gujarat is that there is very little surplus spice available after domestic consumption. Surplus can be improved by the following ways:

- Productivity improvement using the pioneering work done by Gujarat Agriculture University
- Setting up of more infrastructure facilities like drying yards and storage silos.
- Increase in cultivated area
2.5.3 Infrastructure and Agro-Parks

Efficient and, in certain cases, specialized service and infrastructure are an essential ingredients in the development of Agriculture. The agriculture infrastructure can be broadly classified into four area viz., physical availability of Agri-inputs and services, awareness and knowledge building activities in the area of agriculture, policy framework and institutional assistance for the channelised growth of agriculture, and financial credit to improve time-efficiency of the agricultural activities. In general, Gujarat has well developed infrastructure facilities in certain areas, but there is enough scope for developing and upgrading agriculture infrastructure. The potential areas for investment in agriculture infrastructure could be specialized storage facilities, primary and secondary transportation, mechanization, grading standards, export promotion, processing industry support, market intelligence etc.

In certain clusters of the state, there is a scope for developing integrated infrastructure - Agro-parks. Gujarat has certain niche Agri-products like isabgul, horticulture produce, and spices like fennel, cumin, etc. Moreover, these Agri-products are produced in certain geographical clusters which make these clusters prima facie suitable for setting up of common user infrastructure facilities.

Some of the geographical clusters producing niche commodities and could be explored for developing agro parks are; South Gujarat for horticulture, Kutch-Banaskantha for isabgul, Mehsana-Banaskantha for spices. The agro-park would provide services in the areas of primary processing (like cleaning, grading, sorting etc.), transportation, storage, export facilities, specialized cultivation and plant protecting services, business information, market activities, research, etc.

Major commercial crops grown in Gujarat are oilseeds, cotton, isabgul, guar, spices, fruit and vegetables. In case of horticulture crops, Gujarat is in strong position in production of some fruits like banana, chiku and vegetables like onion. One major area of concern across the spectrum, however, is that of low productivity. In general, except the crops which are grown only in Gujarat and India such as cumin and isabgul, Gujarat lacks on productivity front. This position, however, also indicate the potential to become global power in these sectors by improving the yield levels through new methods and application of better technology.
A matrix derived from Gujarat's standing in productivity and production levels as compared to other states (Ref. figure 2.2) provides interesting insights about Gujarat agriculture's competitive advantages and disadvantages. Gujarat has clear cut advantage in the commodities shown in top right hand side quadrant, while in some other commodities, there is a potential to develop advantages. Gujarat..

.. has clear competitive advantage in Fenrel, Chikus, Onion, Banana, Isabgul, and Cumin;
.. has potential to develop competitive advantage in select Fruits & Vegetables (Mango, Potato, Papaya and Guava) and select Spices (Turmeric & Garlic);
.. need to upgrade position (especially w.r.t. productivity) in important spices (Ginger and Chili) and Vegetables (Okra, Brinjal, Tomato).

Figure 2.2
Gujarat: Competitive Position in India

Source: Gujarat Agriprocessing Potential Report 2000-'01, Confederation of Indian Industry, Gujarat
2.5.4 Gujarat's Position in World Agriculture

Gujarat agriculture's comparison with other Indian states provided a good understanding of its strengths and weaknesses. However, in many commodities like Isabgul, spices and select horticulture products, Gujarat has significant competitive advantages even with respect to rest of the world. In table 2.1, Gujarat is compared with rest of world including India in select crops with respect to production and productivity levels.

Table 2.1
Competitive Position of Gujarat vis-à-vis World

<table>
<thead>
<tr>
<th>Crop</th>
<th>Gujarati's position in world production</th>
<th>% of World Production</th>
<th>Gujarati's position in world productivity (MT/ha)</th>
<th>World Average</th>
<th>World's Best / Largest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundnut</td>
<td>3</td>
<td>8</td>
<td>1.35</td>
<td>1.32</td>
<td>L-China (2.6), B-Israe (6.6)</td>
</tr>
<tr>
<td>Castor</td>
<td>1</td>
<td>67</td>
<td>1.98</td>
<td>0.92</td>
<td>2L-China (0.86)</td>
</tr>
<tr>
<td>Sesame</td>
<td>5</td>
<td>6.5</td>
<td>0.51</td>
<td>0.38</td>
<td>2L-China (0.99), B-Lebanon (1.8)</td>
</tr>
<tr>
<td>Cotton</td>
<td>8</td>
<td>3.5</td>
<td>0.36</td>
<td>0.59</td>
<td>B-Israel (1.8)</td>
</tr>
<tr>
<td>Tobacco</td>
<td>7</td>
<td>3</td>
<td>1.6</td>
<td>1.52</td>
<td>L-China (1.8), 2L-US (2.4)</td>
</tr>
<tr>
<td>Cumin</td>
<td>2</td>
<td>36</td>
<td>0.48</td>
<td>0.38</td>
<td>B-Gujarat</td>
</tr>
<tr>
<td>Fennel</td>
<td>1</td>
<td>67</td>
<td>1.53</td>
<td>1.5</td>
<td>B-Gujarat</td>
</tr>
<tr>
<td>Isabgul</td>
<td>2</td>
<td>35</td>
<td>0.71</td>
<td>0.52</td>
<td>B-Gujarat</td>
</tr>
<tr>
<td>Onion</td>
<td>18</td>
<td>6.25</td>
<td>0.66</td>
<td>0.42</td>
<td>B-Gujarat</td>
</tr>
<tr>
<td>Chiku</td>
<td>2</td>
<td>21</td>
<td>8.79</td>
<td>11.93</td>
<td>Only India</td>
</tr>
<tr>
<td>Banana</td>
<td>13</td>
<td>1.89</td>
<td>38.9</td>
<td>14.7</td>
<td>B-Costa Rica (46.6)</td>
</tr>
</tbody>
</table>

*For select commodities only (L: Largest production, B: Best producer i.e. highest yield)


As seen in table 2.1, Gujarat ranks favorably in many commodities even while comparing with rest of the world. Therefore, these commodities can provide competitive advantage for building agro-industries in Gujarat in respective fields. For example, few crops where Gujarat has envious position in the world production are Cumin, Fennel, Castor, Isabgul, Guar, and Groundnut. Other major crops where Gujarat has big advantages include cotton, banana, and tobacco. These crops become source of big advantages due to sheer volumes these commodities

35
has in international scenario. Other crops like onion and sesame can be developed for domestic market, since Gujarat has a dominant position nationally.

The competitive position of Gujarat agriculture is also affected by other sectors in the economy. Since Gujarat is one of the leading states in industrial development, this automatically helped in developing good infrastructure such as roads, ports, power etc. which can be used for building agro-industries. The industries such as packaging and engineering provide the basic framework, which makes it easy to set up agro-processing units.

Unique geographical location of Gujarat provides other advantages such as proximity to big market like Mumbai. Well developed ports and airports provide infrastructure for exploring export markets for new and traditional products. This coupled with entrepreneurial zeal in people of Gujarat makes the prospects of developing agro-industries in near future, and thus helping the state in diversifying the base of economy, very promising. Table 2.2 summarizes the Gujarat's competitive position in the agriculture field.

Table 2.2

<table>
<thead>
<tr>
<th>SWOT Analysis for Gujarat Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths</strong></td>
</tr>
<tr>
<td>• Established Industrial Base with strong agro-industrial base; Strong institutional base for developing agriculture</td>
</tr>
<tr>
<td>• Major participants in India’s Agro commodity exports; Eminent position in production and productivity of major crops</td>
</tr>
<tr>
<td>• Large, talented labor force; Strong Entrepreneurial Base</td>
</tr>
<tr>
<td><strong>Opportunities</strong></td>
</tr>
<tr>
<td>• Opening of economy and GATT agreement to give impetus of agro-exports</td>
</tr>
<tr>
<td>• Investment in infrastructure set to give returns</td>
</tr>
<tr>
<td>• Identification of Agro-industry as a focus area will lead to agriculture development</td>
</tr>
<tr>
<td>• Sardar Sarovar project would expand the area under irrigation</td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
</tr>
<tr>
<td>• Physical Infrastructure bottlenecks in terms of power, irrigation, roads and ports hinder growth of the sector</td>
</tr>
<tr>
<td>• Higher susceptibility to monsoons (Only 1/3rd area is irrigated)</td>
</tr>
<tr>
<td>• Export participation still commodity dominated, Fragmented processing industry which lack economies of scale</td>
</tr>
<tr>
<td><strong>Threats</strong></td>
</tr>
<tr>
<td>• Over reliance on ground water and wrong fertilizer mix would lead to disturbance of ecological balance.</td>
</tr>
<tr>
<td>• Cheap imports might harm specific industries like dairy, due to WTO obligations</td>
</tr>
</tbody>
</table>
As seen in table 2.2, despite much strength, Gujarat agriculture at present faces many problems. The most prominent of these is vulnerability to the vagaries of monsoon as large areas are rein fed. New irrigation projects are necessary to provide the requisite infrastructure for sustainable growth. Other problems like fragmented processing industry and commodity dominated exports can be overcome by consolidating and building agro-industries engaged in manufacturing of value added products. Gujarat has a tremendous potential to develop agro-industry economy in the next millennium. The strategies which can catapult Gujarat into the league of major agricultural powers are:

- Focus on few crops where sustained competitive competencies exist (or can be built)
- Be a technology upgradation leader in these commodities (across the value chain)
- Focus on value added products
- Focus on global integration

### 2.5.5 Agriculture Policy

Agriculture is primarily a state subject as per the constitution of India. The development of agriculture and animal husbandry along scientific lines is assigned to state. Matters relating to preservation, protection and improvement of stock, land and land tenure system and related matters are state subjects. Irrigation and power are also under the purview of respective state legislatures. However, central government is also instrumental in some other aspects related to agricultural policy such as pricing, taxation, etc.

### 2.5.6 Legislative Framework

Though the state has wide legislative powers, the central government can impose controls on agricultural commodities for ensuring standards for goods to be exported or transported from state. The Constitution also authorizes the Centre for control over production and marketing of certain agricultural commodities such as Tea, Coffee, Rubber, Cardamom, Coir, Tobacco, Coconut, Oilseeds and Vegetable oil through statutory boards, as it was considered expedient in public interest. Banking and Insurance cover operations relating to the agricultural sector are also under the Central government purview.
Some Central enactments such as Essential Commodities Act override state provisions in matters relating to regulation and control of supplies, distribution and prices of select agricultural commodities specified under the Act - though the actual administration of the Act is done by the States. The Centre is also empowered to fix minimum and maximum prices for agricultural commodities. However, this is done in consultation with the States. Legislative control of bankruptcy and insolvency is a concurrent subject under which both the Central and the State Government's work in close co-ordination in organizing credit facilities for agricultural activities.

However, there is a close co-ordination between the state and the Centre with respect to the implementation of various legislations, programs and schemes. Centre provides assistance to the States by way of sponsorships and subsidies on various programs and schemes. Some of these are jointly financed both by the Centre as well as the beneficiary states. Thus, the policy framework for Agriculture and allied activities calls for close co-ordination between the Centre and the state.

2.6 Gujarat Scenario - Fruits

Amongst the different states of India, Gujarat ranks 11th in area (2.31% of total Gujarat) and 7th (5.29% of total production) in production of fruits. The state occupies number one position with respect to fruit productivity in the country and productivity of banana.

Eight districts (Kheda, Surat, Bharuch, Vadodara, Valsad, Kutch, Bhavnagar and Junagadh) are the major fruit producing districts in Gujarat and accounts for nearly 85% of the total fruit production in Gujarat. The other 11 districts account for a mere 15% of the total fruit production in Gujarat.

The major fruits grown in Gujarat are Banana (49%), Mango (16%), Papaya (7%), Chiku (5%) and Guava (4%) which together account for 81% of the total fruit production in Gujarat.

Gujarat ranks third in Banana production in India and ranks first in productivity. Gujarat individually ranks 13th in the world production of Banana and accounts for 1.88% of Banana production in the world. Banana is grown mainly in twelve districts but is mainly
concentrated in Kheda (31%), Bharuch (23.25%), Surat (20%), Vadodara (18%) and Ahmedabad (2%). The production of Banana is the highest, almost half of all fruits produced in Gujarat, with July as the beginning of the season, September the peak and December the end (lean) season.

Gujarat ranks the sixth in Mango production in India and the third in productivity. Mango is grown in all the nineteen districts in Gujarat but the top 5 mango producing districts are Valsad (31%), Junagadh (20%), Surat (11%), Amreli (10%) and Bhavnagar (9%). Mango is a seasonal produce with April as the beginning of the season, May is the Peak and June is the end (lean) season.

Gujarat ranks second in Papaya production in India, and in terms of productivity occupy the fourth rank. This fruit grows all round the year. The top 5 producing districts are Kheda (22%), Jamnagar (20%), Ahmedabad (14%), Junagadh (11%) and Kutch (10%).

Gujarat individually ranks second in the world production of Chiku and accounts for 21% of Chiku production in the world. Gujarat ranks second in Chiku production in India, and in terms of productivity, it ranks second. Chiku production is concentrated in the districts of Valsad (31%), Junagadh (20%), Surat (11%), Amreli (10%) and Bhavnagar (9%).

Gujarat ranks fifth in terms of Guava production in India, and ranks first in terms of productivity. Guava is an important fruit grown in Gujarat with November as the beginning of the season, January is the Peak and February is the end (lean) season. The five important districts producing Guava are Bhavnagar (36%), Kutch (13%), Ahmedabad (11%), Sabarkantha (7%) and Bharuch (4%).

2.6.1 Fruit Varieties in Gujarat

Table 2.3 gives the details for main varieties of fruits in the main categories grown in Gujarat along with exportable and processable varieties.
### Table 2.3
Grown, Exportable and Processable Fruit Varieties in Gujarat

<table>
<thead>
<tr>
<th>Fruits</th>
<th>Main Varieties Grown</th>
<th>Exportable Varieties</th>
<th>Processable Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango</td>
<td>Badami (Alphonso), Bannet, Raspuri (Pairi), Totapuri (Bangalore), Neelam, Mulgao, Banganpalli, Dashehari, Langra, Sandura, Keshar</td>
<td>Badami, Totapuri Keshar</td>
<td>Except for Baganpalli, all other local varieties are also processed.</td>
</tr>
<tr>
<td>Banana</td>
<td>Poovan, Dwarf Cavendish, Raspale, Robusta, Nendran, Maduranga, Yelakke, Bale, Chittatar</td>
<td>Chittatar</td>
<td>All local varieties</td>
</tr>
<tr>
<td>Guava</td>
<td>Allahabad Safeda, Sardar Guava, Red Guava</td>
<td>Red Guava</td>
<td>All Local varieties</td>
</tr>
<tr>
<td>Chiku</td>
<td>Kalipatti, Cricket Ball, Calcutta Round</td>
<td>All local varieties</td>
<td>All local varieties</td>
</tr>
<tr>
<td>Papaya</td>
<td>Coorg Honey drew Washington, C0-1, C0-2, Solo and other local varieties</td>
<td>All local varieties</td>
<td>All local varieties</td>
</tr>
</tbody>
</table>

Source: National Horticulture Board, APEDA

#### 2.6.2 Pre Harvest Activities and Facilities

The fruit trees can be cultivated by farmers from seeds or from small plants which are directly procured from the nurseries. But the farmers generally procure the small plants from the 295 government run nurseries in Gujarat. Of these 103 (35%) are concentrated in Junagadh followed by Valsad (35%) and Ahmedabad (10%). Many a times, the nurseries can't meet the demand, and the farmers are compelled to source there requirements from other areas. The problem is acute in the case of minor fruits.

The farmer, at times, may also procure seeds from the Gujarat Seed Certification Agency and Gujarat Seed Corporation which sell through farmers' co-operative societies at concessional rates. If there is a shortage at the above mentioned government agencies, farmer may buy seeds from the Private Seed Companies.
2.6.3 Post Harvest Activities and Facilities

Figure 2.3 gives the movement of fruits (same for vegetables) from the farm to the end user. The fruits are brought to the co-operative societies for sale. Bulk purchasers of fruits (like wholesalers, distributors, food processing companies) purchase the fruits from these co-operative societies through auction.

Presently, very little of sorting, grading and packaging of fruits happens in Gujarat. Sorting, grading and packaging facilities are not yet well established in Gujarat. If these facilities are provided, it will lead to better price realization for farmers and reduce wastages. These facilities would also help in the export promotion of horticulture produce.

2.6.4 Fruit Usage and Consumption

Fruits are generally consumed in the raw form or in the processed form. The usage and consumption of fruit and vegetables has been discussed in detail in the latter part of the chapter, along with vegetable usage and consumption.
2.7 Gujarat Scenario - Vegetables

Amongst the different states of India, Gujarat ranks 12th in area (1.84% of total Gujarat) and 9th (2.60% of total India production of vegetables) in production of vegetables. The state occupies number one position in the country with respect to productivity of Potato and Onion. Eight districts are the major vegetable producing districts in Gujarat, accounting for around 74% of the total Gujarat vegetable production. The other 11 districts account for a mere 26% of the total Gujarat vegetable production.

The major vegetables grown in Gujarat are Potato (28%), Onion (28%), Brinjal (13%), and Tomato (7%); and they together account for 76% of the total vegetable production in Gujarat.

In India, Gujarat ranks seventh in Potato production, and ranks first in productivity (23,340 kg/ha). Potato is grown mainly in ten districts, and is mainly concentrated in Banaskantha (32%), Kheda (24%), Sabarkantha (15%), Mehsana (14%) and Ahmedabad (8%), being the top 5 districts.

Gujarat individually ranks 18th in the world for Onion production and accounts for 1.5% of the world onion production. Gujarat ranks second in Onion production in India, while in terms of productivity, it ranks first (25,120 kg/ha). Onion is grown in all the nineteen districts in Gujarat, and the top 5 districts producing Onion are Bhavnagar (34%), Panchmahal (21%), Junagadh (19%), Amreli (10%) and Rajkot (5%).

Gujarat ranks eighth in Brinjal production in India and 13th in productivity (12,720 kg/ha). Gujarat also ranks twelfth in Tomato production, while in terms of productivity, it ranks tenth (15 Kg/ha) amongst the different states in the country. Brinjal is grown in all the districts, and the 5 top producing districts are Kheda (8%), Junagadh (10%), Surat (9%), Vadodara (8%) and Rajkot (5%). Tomato is grown in all the districts and the top 5 producing districts are Vadodara (17%), Valsad (10%), Ahmedabad (9%), Kutch (8%) and Bharuch (7%).
2.7.1 Vegetable Varieties in Gujarat

Table 2.4 gives the details of main varieties of vegetable in the main categories grown in Gujarat, along with the other exportable and processable varieties.

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Main Varieties Grown</th>
<th>Exportable Varieties</th>
<th>Processable Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>Kufri, Jyothi, Kurfri handramukhi</td>
<td>Jyothi, kufri</td>
<td>All local varieties</td>
</tr>
<tr>
<td>Onion</td>
<td>Bellary Red, Pusa Red, Arka Niketan, Arka Kalyan, White Cultivars and Red Cultivars</td>
<td>Pusa Red</td>
<td>Mainly Pusa Red</td>
</tr>
<tr>
<td>Tomato</td>
<td>Pusa Rubi, Karnataka Hybrid, Rupali, Vyshali, Arka Sourab, Arka Vikas, Naveen</td>
<td>Mainly Hybrid Varieties</td>
<td>Mainly Hybrid Varieties</td>
</tr>
</tbody>
</table>

Source: National Horticulture Board

2.7.2 Pre and Post Harvest Activities and Facilities

The Pre and Post harvest activities and facilities are similar as that of fruits and are discussed in the fruit sector. But the difference lies in the life of the fruit plant (which is generally a tree), the fruit tree has a longer life and gives multiple fruit output/seasons, whereas in the case of vegetables the life of the plant is generally less than a year. Hence the cultivation methodology is different in the case of fruit and for vegetable.

2.7.3 Usage of Fruit and Vegetables

Majority of fruits and vegetables in India are sold to the end user in the raw form. Currently a small percentage of fruits and vegetables go into processing. It is estimated that the total quantity of fruits and vegetables processed in Gujarat is less than 2% of the total quantity harvested in the state.
Most of the canning, pulping, juices making units are located in the districts of Valsad, Surat, Ahmedabad, Rajkot and Kheda. Dehydration units for vegetables are concentrated in Bhavnagar. Incidentally, even though Sabarkantha is one of the major fruits and vegetables growing districts, it does not have a single food processing unit.

2.7.4 Institutional Initiatives in Horticulture

The National Horticulture Board, promotional body in accordance with the Central Government objectives, is providing soft loan assistance to take up programs right from production to processing of horticulture produce particularly in the hi-tech areas in Gujarat. During 1999-2000, the Board has allocated an outlay of Rs 125 crore for the implementation of these projects.

The government is planning to set up Green House technology for fruits and vegetables, tissue culture for fruits and vegetables, post harvest handling of fresh fruits and vegetables, processing of dehydrated fruits, pulps, and juice. With the promotional efforts from National Bank for Agriculture and Rural Development (NABARD) like conducting seminars, the financing of this sector in the state has slowly gathered momentum.

The Directorate of Horticulture, Government of Gujarat and Banks have suggested the establishment of more nurseries, in Saurashtra and North Gujarat districts, also encourage private investment, and enhancing subsidy component in the existing schemes. The State and Central Government has decided the need to upgrade and encourage EOUs in the State. For corporatization of Plant & Horticulture sector existing land laws may be relaxed.

The Gujarat Seed Certification Agency and Gujarat Seed Corporation produces seeds on a mass scale, which are distributed to the farmers at concessional rates. Recently, NHB has announced a Capital Investment Subsidy Scheme (CISS) for the construction / expansion / modernization of cold storages and storages for horticulture products. A subsidy of 25% (maximum up to Rs. 50 lakh) will be provided for projects up to 5,000 MT capacity (maximum capital expenditure Rs. 2 crore @ Rs. 4,000/MT).
2.7.5 Price Trends

There are approximately 31 market centers in India. The fruits & vegetable prices are fixed at each market centre. Prices are generally higher in the Northern markets as compared to the Southern and Western centers (which are the major fruit & vegetables growing belts).

2.7.6 Investment Opportunities in Gujarat

Gujarat offers tremendous potential for promotion of food and food processing, especially in Horticulture. Primarily, the opportunities for investing in horticulture exist in the post harvest phase. The potential investment could be in the following areas:

- **Primary activities**
  - Cleaning
  - Grading
  - Sorting
  - Packaging, etc.

- **Secondary activities**
  - Processing units
  - Dehydration plants

- **Support Infrastructure**
  - Cold Chains
  - Export Facilities

**Primary Activities**

Activities such as sorting, grading, and packaging facilities have not yet been established in the state. Currently, although the co-operative marketing societies play a significant role in the post harvest phase, but do not provide any value added services like sorting, grading, etc. due to lack of infrastructure. Private parties in conjunction with the Gujarat government could offer such facilities. It is recommended that these services should be benchmarked against the International Standards in order to have a competitive advantage in the long run.
Secondary Activities

Fruit and vegetable processing account for less than 2% of the total quantity harvested in the state. There is significant potential for investing in food and horticulture processing. A Food Park concept may be thought for the Fruit and Vegetable sector and a common infrastructure could be developed as common user facilities. The concept of dehydration of vegetables is also gaining importance in India. The following paragraphs discuss in brief about demand for dehydration in domestic and export markets.

Domestic Demand - Dehydrated Products

Soup Industry is the largest user of the dehydrated vegetables by several MNCs such as CPCl International (Knorr), Nestle (Maggi), Unilever (Brooke Bond), and Campbell Soup. Potatoes, Onions, Tomatoes, Carrots, Peas, Mushrooms, Cabbage, Asparagus, and Parsley are the most popular dehydrated ingredients with Broccoli quickly becoming another important soup ingredient. Dehydrated onions are the most frequently used seasoning components in processed foods. Pet foods use primarily carrots and onions.

Institutional foods service and catering sector is another important segment which uses one third of all dehydrated vegetables supplied as substitute for fresh produce.

Support Infrastructure

It has been estimated that about 40% of horticulture wastage account from the post harvest losses. There exists a need for setting up cold storage chains in the state. Most of them are located at the districts places, and are not easily accessible directly to the farmers. An integrated network of multi-purpose, multi-user storages, adequate transport facilities with infrastructure in the areas of horticulture clinic, grading and packing centre, etc. should be encouraged in order to improve the horticulture value chain efficiency. These kinds of facilities can be created with the help of private sector participation.
2.8 Gujarat Scenario: Spices

Spices are widely used all over the world as food flavoring ingredients as well as treating variety of ailments. There is awareness that spices have an important role in nutrition. They stimulate appetite by increasing salivation, relieve gastric discomfort and flatulence. They are also powerful germicides. Spices are broadly classified depending upon the part of the plant from which the spice is obtained viz. rhizomes and root spices, bark spices, leaf spices, flower spices, fruit spices and seed spices.

Although, nearly 60 out of the recorded 107 spices are cultivated in India, only 16 are important as they find reasonable amount of usage. And out of these 16 spices only 8 are main / basic spices, accounting for more than 94% of all India spice production. Table 2.5 lists the 8 main / basic spices along with their scientific and the Indian/local names.

Table 2.5

<table>
<thead>
<tr>
<th>English Common Name</th>
<th>Scientific Name</th>
<th>Indian Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chili</td>
<td>Capsicum annum</td>
<td>Mirchi</td>
</tr>
<tr>
<td>Coriander</td>
<td>Coriandrum sativum</td>
<td>Dhaniya</td>
</tr>
<tr>
<td>Turmeric</td>
<td>Curcuma longa</td>
<td>Haldi</td>
</tr>
<tr>
<td>Cumin</td>
<td>Cuminum cyminum</td>
<td>Jeera</td>
</tr>
<tr>
<td>Garlic</td>
<td>Allium sativum</td>
<td>Lasuun</td>
</tr>
<tr>
<td>Fenugreek</td>
<td>Trigonella foenum-graecum</td>
<td>Methi</td>
</tr>
<tr>
<td>Ginger</td>
<td>Zingiber officinale</td>
<td>Adrak</td>
</tr>
<tr>
<td>Pepper</td>
<td>Piper nigrum</td>
<td>Kali-Mirch</td>
</tr>
</tbody>
</table>

Source: Spices Board of India

Out of these 8 spices, Gujarat mainly produces three types viz. chili, cumin and garlic. Gujarat also produces fennel seed spice in huge quantity. This chapter covers all spices but the above mentioned four are discussed in more detail.
2.8.1 Overall Usage and Applications

Spices are extensively used as flavoring agents in various food products. It is used in the pharmaceutical industry, especially in the preparation of Ayurvedic medicines. Spices are also frequently used in home made medicines for different ailments. The new group of value-added products such as the volatile oils and oleoresins obtained from spices are also in large demand in the international market as food ingredients. The volatile oil is also used in flavoring liquors and obscuring unpleasant smell of medicines.

India has been and is one of the largest producers and consumers of a very large variety of spices - over 50 species of spices totaling over 2.5 million tons per annum. Apart from its traditional role to provide the culinary variety, palatability, spices are now credited with the roles of antioxidant, digestive and curative properties. Hence, spices are now finding much wider acceptance in continental and international cuisines.

The processing sector consists of very large number (over 16,000) of highly dispersed units in the cottage sector and about 50 units in the organized sector which includes a few units producing value added products like spice oils and oleoresins for export. The value added product groups that deserve attention, considering their potential in domestic and international markets are ground spices, curry powders, spice oils and oleoresins.

2.8.2 Spices - End Products

The market for spices can be broadly classified into:

- **Straights**: This refers to spices sold in natural form or 'straight powder' form (for e.g. Red Chilies and Red Chili powder). Since the product is basic, value addition is low. Straights can be further classified into:
  - **Main (Basic) Spices**: These are the 8 main/basic spices which account for over 94% of all India spice production viz. chilli, coriander, turmeric, cumin, garlic, fenugreek, ginger and pepper.
  - **Smaller/Exotic Spices**: This represents a group of around 20 spices like cinnamon, cardamom, clove, nutmeg, celery, fennel, tejpat, saffron etc. which
are spices occasionally used. These are low volume spices and together account for only 6% of the total spice production in India.

**Value Added Products:** This represent the value added part of the spices market and consists of a variety of masalas used to enrich the food, oils and oleoresins.

- **Blends/Masalas:** This refers to various blends of spices that are pre-mixed in the right proportion to enhance taste and simplify preparation of the dish.
- **Spice Oils:** These are highly value added products produced by extraction from the spices. Spice oils are also called Spice Essential Oils. They are the volatile aromatic extracts prepared by steam distillation of ground spices. Spice oils have the major advantages such as standardization, consistency and hygiene. The standard of oil differs on the end usage. Therefore they are custom-made to meet the exact requirement of the end user. Spice oils are mostly used in food, cosmetics, perfumes and personal hygiene products such as toothpastes, mouthwashes etc. It is also used in pharmaceutical formulation.
- **Spice Oleoresins:** Spice oleoresin represents the complete flavor profile of the spice. It comprises of both volatile and non-volatile resins present in spices. Oleoresins can be defined as the true essence of the spices and can replace whole/ground spices without impairing any flavor and aroma characteristics. These are prepared by solvent extraction of coarsely ground spices using suitable food grade solvents like hexane, ethylene-dichloride etc. Spice oleoresins guarantee superior quality of flavor and aroma. They are complete and balanced, consistent and standardized. They ensure storage stability in the final product and are free from contamination. Spice oleoresins are mainly used in processed meat, fish and vegetables, soups, sauces, chutneys, cheeses and other dairy products, baked foods, confectionery, snacks and beverages.

**2.8.3 Quality Aspects**

Export of value added spices like encapsulated spices, oils and oleoresins are assuming significance in view of convenience and the aflatoxin problems in bulk spices. All the importing countries, especially in the developed world, require the spices to be clean without
any food additives and extraneous matter. They also want the spices to have safe level of moisture, adequate level of flavorings constituents like volatile oil or pungent principle etc.

Quality is affected by various factors like climatic conditions, maturity at harvest, drying storage practices etc. The main parameter for evaluating the quality is the flavor/aroma of the spice which is due to its volatile oil contents and its other constituents. The relative importance of these qualities depends upon the end use of the spices. For a whole seed, the appearance is the primary quality determinant. For extraction purpose, the quantity of volatile oil or the pungent principle is important. These characters vary from spice to spice.

2.8.4 Quality Requirements

The importers prescribe grade specification for various spices depending on the end uses. In India the quality of the spices is mainly governed by specifications laid down by PFA (Prevention of Food Adulteration Act, 1956) and AGMARK (Agricultural Produce Grading and Marking Act, 1937). The Agmark grade specifications have been drawn out for spices on the basis of their age-old and familiar trade names. Agmark specifications have been prescribed taking into account individual characteristics of spices like color, size, density, moisture content, presence of extraneous matter, damaged produce etc.

Many importing countries have their own quality grading and certification systems for e.g. USA has FDA (Food and Drug Administration) and Japan has Food Sanitation Law. Maximum residue of insecticide & pesticide, and tolerance limit for aflatoxin in spices are prescribed by these countries. The quality of spices is evaluated by the following three techniques:

- Physical or sensory evaluation
- Physico-chemical analysis
- Nutritional assessment

Gujarat mainly produces chilies, cumin, fennel and garlic which together account for about 81% of the total spice production of Gujarat. The individual production of other minor spices such as fenugreek, ginger, coriander etc. is marginal and is consumed locally. Fig 2.4 shows the major spices growing districts of Gujarat which are;
2.8.5 Spices: Post-harvest activities

The post-harvesting of spices consists of the following activities:

- **Drying**: After the harvest the spices are sun dried on suitable clean surfaces.
- **Storage**: Adequate protection from dampness and rain is ensured. Storage is periodical exposed to the sun. Protection from rodents, insects and other animals is also ensured.
- **Spice Grinding**: If spices are to be sold in powdered form, grinding is done with rotator plates with adjustments done for the desired fineness.
• **Packaging:** Packaging is done to increase the shelf life as well as to give information about the products. It is increasingly being used to fetch a premium price in the western markets. Bulk packaging is normally done in jute bags while smalls are packed in plastic films, foils and laminations.

2.8.6 Business Chain

Spices produced by the farmers are normally brought to the Agricultural Produce Market Yard (APMC) by the farmer or the village trader/broker. The spices are auctioned in the APMC to the buyers. Figure 2.5 gives the whole business chain of spices. The major markets for the spices are as follows:

- Chilies: Unjha and Mehsana
- Cumin: Unjha, Patan, Mehsana and Visnagar
- Fennel: Unjha, Visnagar, Nadiad and Vijapur
- Garlic: Surat, Jamnagar, Ahmedabad and Visnagar

Figure 2.5

Business Chain for Spices
In spice markets, there are two categories of buyers viz.

- **Exporters/Commission Agents**: These agencies purchase the produce directly from APMC and send the produce to markets at the main cities in India or export to foreign countries.

- **Wholesalers/Processors**: Wholesalers directly sell the purchased produce to the retailers. Processors grade and package the produce and add their brand name before supplying it to the retailers. Processors also make other enc products like masalas, oils & oleoresins.

### 2.8.7 Investment Opportunities in Gujarat

Gujarat is the largest producing state of cumin (42.9% of India's production, area & productivity are 120,900 Ha and 0.48 MT/Ha) and fennel (81.7% of India's production, area & productivity of 20,500 and 1.53 MT/Ha) while it is the second largest producer of garlic (22.6% of India's production) after Madhya Pradesh. Rajasthan is the main competitor to Gujarat in the production of fennel and cumin. There is opportunity for Gujarat in the areas of research, production and marketing of these three spices.

The main problem faced by the spice industry in Gujarat is that there is very little surplus spice available after domestic consumption. Surplus can be improved by the following ways:

- Productivity improvement using the pioneering work done by Gujarat Agriculture University
- Setting up of more infrastructure facilities like drying yards and storage silos
- Increase in cultivated area

Another problem faced by the industry is the poor overall quality of the produce. The good quality produce gets mixed up with bad quality produce at the APMC rendering the whole lot as bad quality and un-exportable. Adequate cleaning, grading & sorting centers and laboratories are required at all major markets of spices to address this problem.
There is great opportunity for Gujarat in downstream value adding processing industries in spices. As mentioned earlier the average price realization on value added spices (Rs. 100,000/MT) is double that of straight spices (Rs. 50,000/MT). Value added spice exports of India are growing at a rate of 30.7% in value terms. Further spice oleoresins as a category is growing at a phenomenal rate of 121% in value terms. There are negligible processors for encapsulated spices, oils and oleoresins in Gujarat. There is tremendous opportunity for Gujarat in these sectors.

2.8.8 Potential Areas of Investment

As discussed earlier, Gujarat provides ample opportunities in the emerging sector value added spices. The following projects can be undertaken;

- Dehydrated Garlic Flakes & Dehydrated Garlic Powder Plant
  - Location: Junagadh or Jamnagar
- Cumin and Fennel Oleoresin Plant
  - Location: Mehsana

The food processing industry is one of the prime industries in our country. The country produces over 75 million tones of fruits and vegetables and 250 million tones of food grains. However, of the total production of fruits and vegetables hardly 2.5 lakh tones are processed. Thus the fruit and vegetable processing and preservation industries utilize less than 1% of the total production of fruits and vegetables; thereby, playing an insignificant role in the prevention of wastage of agro products. As a result, the cost of processing very small quantities is high and therefore the cost of processed fruits goes beyond the reach of most of our population.

Accelerating the pace of processing agro produce would be beneficial in two ways. Firstly it tends to reduce post harvest losses by enhancing the utilization of available produce. Secondly, it provides an opportunity to generate employment potential by running a viable industrial unit. Food processing offers excellent scope for development in an agrarian economy like India. That India produces a wide range of fruits and vegetables are incentives for the development of food processing industry.
2.9 Agro and Food Processing Industry

In the research paper "Marketing of protein-rich foods in developing countries" the author examines the possibilities of marketing formulated commercially distributed foods for combating malnutrition in low-income developing countries. The research paper looks at the general character of consumer demand and distribution of purchasing power, while also investigating income as a determinant of nutritional status. It is suggested that in developing countries there is a need for low-cost nutritious foods being stressed by marketing departments in order to tempt the consumer.

The agro and food processing sector in India stands apart from other sectors of economic activity by virtue of its special characteristics such as, vast resource base, diversity of agro-climatic conditions under which the resources are produced, the chain of intermediaries directly or indirectly involved from the stage of production to the final stage of consumption and the significant share of the resources being utilized or consumed in the primary stage itself.

The industry that began with bread and biscuits, has now gone into extrusion processing of cereals and pulses, oilseed processing, super critical fractionation of oleoresins, confectionery, dairy products, dehydrate vegetables, Soft drinks etc.

The Eighties have seen a phenomenal expansion in the food processing industry in India, attributed mainly to the technological revolution in processing and packaging. A new range of products have come to the market, easy to handle, having long shelf life, without air-conditioned storage, and that are ready to eat.

Presently, the Indian food processing industry is largely involved in primary processing, accounting for over 80 per cent of the output value. According to a recent study (FAIDA report by McKinsey's), the size of the Indian food industry is of the order of Rs. 2,500 billion in

---

1997; this is expected to double by the year 2005. And processed foods will grow at an ever faster rate, rising from Rs. 800 billion to Rs. 2,400 billion during the same period.

Considering the resources on with which they are based, the agro and food processing sector can be categorized into the following sub-sectors.

- Cereal processing
- Fruit and vegetable processing
- Animal product foods
- Marine and inland fish processing
- Dairy processing
- Plantation and nut foods
- Spices and flavor foods
- Oilseeds and oil processing
- Sugar and confectionery products
- Beverage foods
- Baked foods
- Traditional foods

Out of the above twelve important sub-sectors, this research work concentrates on two select sub-sectors of fruits and vegetables processing, and spice products, as these sub-sectors present a large scope for making impact on export performance through technology upgradation, modernization and policy initiatives for empowering the large number of tiny, small and medium enterprises in these two sub-sectors.

---

2.10 Fruit and Vegetable Processing Industry

In the literature review on the topic of “consumer acceptance of functional foods: issues for the future”\(^9\) the authors note that in the past, it has been assumed that consumers would accept novel foods if there is a concrete and tangible consumer benefit associated with them, which implies that functional foods would quickly be accepted. However, there is evidence that individuals are likely to differ in the extent to which they are likely to buy products with particular functional properties. Various cross-cultural and demographic differences in acceptance found in the literature are reviewed, as well as barriers to dietary change. In conclusion, it is argued that understanding consumers’ risk perceptions and concerns associated with processing technologies, emerging scientific innovations and their own health status may enable the development of information strategies that are relevant to wider groups of individuals in the population, and deliver real health benefits to people at risk of, or suffering from, major degenerative illnesses.

In another research paper on ‘older people’s perceptions towards conventional and functional yoghurts through the repertory grid method: a cross-country study’\(^10\) the authors investigate older people’s perceptions, across eight European countries (the UK, Denmark, Germany, Poland, Portugal, Spain, Sweden and Italy), towards functional foods. The repertory grid method was used to elicit reasons underlying preferences of five yoghurts with different functional properties and two conventional ones. The findings suggest that familiarity was the key driver in products’ separation. For the Italian case, as well as the Spanish, Portuguese, Danish and Swedish the first principal axes could be interpreted as novel-common axis, whilst it was not in the UK, Germany and Poland. Research limitations/implications – Behavioral intention to buy functional yoghurts was more strongly predicted and moderated by single item perceived need (PN) than single item affective and/or cognitive attitude (AA, CA), even though PN, AA and CA could be consistently assessed within the same latent measure (in all countries but Denmark). Nevertheless, beliefs/attitudes towards a novel category of products such as

functional foods may be reasonably keeping moving. In this study, preference instructions pertaining to beneficial and imagery attributes revealed idiosyncratic properties associated with functional yoghurts across eight European samples of older people.

There are approximately 5,000 Food Processing Units in the country. The fruits and vegetables processing industry have an estimated annual turnover of nearly Rs 8.5 bn. Of the total of fruits and vegetable production only approximately 1.8% goes for value addition in the processing industry as against 40% in other developing countries like Thailand, Sri Lanka, and 70% in developed countries like USA and Canada. Since liberalization and withdrawal of excise duty on fruits and vegetable products, there has been a significant increase in the growth of the industry.

Changes in the export-import policies and exchange rate adjustments have helped in improving the export potential. But to make a reasonable impact in fruit and vegetable processing, the industry will have to change in character from being a collection of discrete and small food processors, as of now to large food chains integrating agricultural extension work to mass outlets for processed products.

2.11 Policies and Regulations in India

In a research paper “foods that help prevent disease: consumer attitudes and public policy implications”\textsuperscript{11} the authors state that over half of the adult US population (55 percent) believes in the disease-preventative properties of natural foods such as fruits, vegetables and cereal grains. Consumer belief in the nutraceutical category has increased significantly in the past two years. The segmented nature of consumer beliefs, interest, and product preference in this new nutritional category suggest a more targeted approach to public health education policy, as well as marketing plans, when introducing consumers to the preventative health advantages of such foods.

Though no industrial license is required for setting up fruit and vegetable processing units, setting up of Export Oriented Unit (EOU) requires special approvals. The sector is regulated by the Fruit Products Order (FPO 1955) issued under the Essential Commodities Act. The Ministry of Food and Processing Industries administers this order. The order lays down product specifications and quality control requirements or product-hygiene, re-labeling, and marketing of processed fruits and vegetables.

Many F&VP industries are eligible for automatic approval of foreign technology agreement up to 51% foreign equity participation. These include tomatoes, mushrooms, and other frozen vegetables, fruit, nuts, fruit-peel, fruit jellies, marmalades, fruit juices and vegetable juices.

The Ministry of Food and Processing Industries provide assistance to this sector through several plan-schemes, viz. schemes for creating infrastructure, development of backward linkages, R&D and training etc. There are some other organizations like APEDA and NHB which help in arranging inputs, export markings etc.

However, in terms of processing of fruits and vegetables, the industrial performance has been very minimal. There are over 5000 units licensed under the FPO to process fruits and vegetables, with an aggregate installed capacity of more than 1.1 million tones per annum. Most of the units are in the cottage and tiny sectors and use outdated technology. The industry is also plagued by low capacity utilization. As a result, the percentage of total fruits and vegetables processed is less than 2%. This compares very unfavorably with countries like Malaysia (83%), Philippines (78%), Brazil (70%) and USA (70%).

Approximately 30 to 40% to the production is wasted during the various stages like picking, harvesting, packing, transportation, storage, marketing and consumption. With the availability of adequate cold storage facilities, better means of packing and proper transport, these wastages can be avoided. In short, there is a need for better post harvest and processing facilities. These reasons have also made it difficult for Indian horticultural products, to compete in the global markets. The constraints of air cargo space and high air freight rates compared to other countries also act as impediments to exports. Under the export-import policy, horticulture has been
identified as a thrust area with an emphasis on exports of fresh fruits and vegetables, processed fruits and vegetables and floriculture.

Several incentives are available for export of horticultural products under the exim policy. Under the duty drawback scheme, all taxes paid by the exporter on indigenous and imported inputs are refunded in full. The advance license for 'Export Production Scheme', allow duty free access to import of raw materials and inputs. The export promotion capital goods (EPCG) scheme has undergone some changes recently and is now extremely exporter-friendly. Under this scheme a unit is entitled to import capital goods at a concessional duty of 15% if it undertakes to export four times the value in five years. Many new units which have both the domestic and export market in mind prefer to avail the EPCG scheme. Another new benefit which is specially designed to promote horticulture exports is the introduction of the concept of 100% export oriented horticulture estates. Under this scheme a horticulture estate or a manufacturing unit processing agricultural or horticultural products is allowed full benefit of a 100% EOJ, if it exports at least 50% of its production. The exporter thus gets the benefit of importing all his capital goods, raw materials and consumables without duty while having access to sales in domestic market up to an enhanced limit of 50% the production.

Apart from the incentives available under the exim policy, the Agricultural Processed Foods Export Development Authority (APEDA) has introduced a number of schemes whereby technical and financial assistance is given to the horticulturists specifically to improve their exporting capacity. The details of the assistance can be had from the organization.

It is now envisaged that various efforts initiated by the government would aid the growth of the fruit and vegetable processing sector. As the trends emerge with the concerted efforts, an annual growth rate of 16% is being projected in industrial circles.

2.12 Growth Pattern and Current Profile

2.12.1 Fruit and Vegetable Processing

India produces about 11 per cent of the world's vegetables and 13 per cent of the fruits. It is
the second largest producer of vegetables and largest producer of fruits with an estimated
production of over 130 million tons; yet, its market share of the world trade in processed fruit
and vegetable is less than 1 per cent. Moreover, the per capita consumption remains at sub-
optimal level of adequacy, largely due to the high percentage of pre- and post-harvest losses.

The fruit and vegetable processing industry comprises (i) preservation by canning, (ii)
preservation by freezing, (iii) preservation by dehydration, (iv) preservation by freeze drying and
(v) value added products, sauces, jams, squash, chutneys, etc. The processing sector in fruit
and vegetable handles only very insignificant share of the total production, almost only one
percent. The distribution of the fruit and vegetable processing industry by scale of operation
indicates that the small scale sector is a major player in the variety of products. The installed
capacities of fruit and vegetable processing industry grew from 8.94 lakh tons in 1991 to 21.0
lakh tons in 1999. In the same period, the production of fruit and vegetable products
showed a growth of over 300 per cent in volume terms.

Most of the fruits and vegetables are seasonal, and preservation and processing make them
available, for extended periods, in hygienic conditions, at a cost. The products are
convenient and economical enough to be used and hence, patronized now by urban
middle and upper class, working families, large scale catering establishments and in defense
rations. Varied domestic factors have, in the past, negatively influenced the consumption of
processed fruit and vegetable products. The most crucial factor has been the inability of
the government to consider that processing, preservation and packaging essentially
‘make today’s produce available for tomorrow’ and is a ‘process of conservation’ of
perishable commodities.

There has been a change in the trend of product mix of the industry over the years,
responding to the market needs in the domestic and international markets. The most
significant rates of growth in production were achieved by fruit juices, frozen vegetables,
dehydrated vegetables and fruit pulps.
Fruit juice industry has been one of the world's major agro businesses. The world trade in fruit juices and concentrates estimated to be around Rs. 250 billion. The main user of fruit juices and concentrates in bulk has been the beverage industry, but other food industries including dairy industry also use some quantities in the manufacture of items like yoghurt, yoghurt drinks, ice-cream puddings, desserts and sauces. In addition to fruit juice pulps, this industry uses fruit pieces, chunks either in frozen or canned forms. Other industries using tropical fruit juices are bakery foods, baby foods, jams and confectionery. Juices and nectars are sold primarily in carton packs, whereas fruit juice drinks are usually marketed in bottles especially domestic brands with relatively low fruit juice content. Fruit juices in tetra pack are gaining ground in the domestic market.

The fruit juice market will develop further in the future and provide interesting outlets for fruit juices; in particular, orange and other citrus juices from developing countries are produced in large quantities and are well accepted by consumers in most markets. Prospects for pineapple are expected to remain good provided that a high quality product at reasonable price can be regularly supplied. The most traded juices after pineapple are passion fruit, mango and banana. Until recently, passion fruit was the most popular drink, but mango and banana have been consumed by majority of consumers in recent years.

Among the fruit juices/pulps production and export, the prime place has always been that of mango pulp. India's destination of export has also remained largely constant, the major importers being the Gulf countries (Saudi Arabia, United Arab Emirates and Kuwait) and smaller quantities reaching the Netherlands, Federal Republic of Germany, United Kingdom and United States of America.

2.12.2 Dehydrated Fruits and Vegetables

The major products in demand are dried non-leguminous vegetables in whole, in cut, sliced or powdered form. The demand is for dried product, through mechanical dehydration process, such as, hot-air dried or freeze dried, rather than being sun or field dried. The list includes a variety of vegetables commonly consumed, such as, tomatoes, onions, mushrooms, etc.
2.12.3 Market Segments

It is difficult to make a clear distinction between the various market segments for dehydrated vegetables and fruits, because these products have various end-uses involving most types of industries. The following market segments are common in the world markets:

- **Soup industry**: Largest end-users especially onion, tomatoes, garlic, mushrooms, asparagus, parsley, bell peppers, cabbage, cauliflower, carrots, etc.
- **Instant mixes industry**: snack and savory
- **Food services**: Canteens, cafeterias, armed forces' ration and expeditions
- **Confectionery industry**: all dehydrated fruits in different forms and style
- **Breakfast food industry**: milk, cereal and fruits and vegetables based
- **Retail trade**: good scope for vegetables and fruits in dried form

2.13 Current Status of Technology

Michael Heasman in the research paper on ‘nutrition and technology: the development of the market for “Lite” products’\(^{12} \) describes that one of the major technological changes in food products over the last decade has been the development of “lite” food and drinks. These products have become regular items of purchase and acceptance in UK diet. The principal areas of growth in the “lite” market have been in sugar-free drinks and low fat foods. Whilst market growth has been stimulated by increased consumer awareness of diet and nutrition, consumers are being influenced by the image message associated with such products rather than a strict health message. Harmonization of European food law after 1992, especially in respect of sweeteners, offers potential opportunities for further growth in “lite” markets. Fat replacers are likely to provide an area of future interest as long as concerns about the mass marketing of synthetic foods do not dampen the market.

A close and careful analysis of the technologies in the field of agro and food processing reveals that the pace of technological upgradation in the developed countries with emphasis

---

on product quality, product process and cost-effectiveness has far outstripped the slow pace of modernization in India. A comparative position is given in the Table 2.6

Table 2.6

<table>
<thead>
<tr>
<th>Products</th>
<th>Technology in India</th>
<th>Technology in China</th>
<th>Technology in Europe</th>
<th>Technology in Far East Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineapple</td>
<td>Canning</td>
<td></td>
<td></td>
<td>Aseptic processing and canning</td>
</tr>
<tr>
<td>Other fruits and berries</td>
<td>Canning</td>
<td>Aseptic processing</td>
<td>Aseptic processing and IQ freezing</td>
<td>Aseptic processing and IQ freezing</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Canning and thermal dehydration</td>
<td>Canning and thermal dehydration</td>
<td>Accelerated freeze drying individual quick freezing</td>
<td>Accelerated freeze drying + individual quick freezing</td>
</tr>
<tr>
<td>Fruit pulps/purees</td>
<td>Canning and aseptic processing, filling, and packing</td>
<td>Aseptic processing, filling, and packing</td>
<td>Aseptic processing and freezing with technology upgraded to pack fruit pieces with pulp (particulate)</td>
<td>Aseptic processing, filling, and packing. And technology upgraded to pack fruit particulate with pulp.</td>
</tr>
<tr>
<td>Fruit slices and segments</td>
<td>Canning</td>
<td>Canning and IQ freezing</td>
<td>Canning and IQ freezing</td>
<td>Canning and IQ freezing</td>
</tr>
<tr>
<td>Fruit pulp preservation to manufacture jams, jellies, and fruit squashes or sherbets</td>
<td>Chemical preservation</td>
<td>Aseptically processed natural pulps</td>
<td>Frozen to preserve freshness and natural characteristics</td>
<td>Frozen to preserve freshness and natural characteristics</td>
</tr>
</tbody>
</table>

A sectoral analysis of current technologies is presented below.

2.13.1 Fruit Pulps / Juices / Concentrate

The essentials of the technology for production and packaging of tropical fruit pulps such as, mango, guava or fruit juices, such as, pineapple, orange, apple are briefly discussed.

**Preparation:** Preparation includes operations, such as, washing, grading, peeling and slicing. Except in a few of the large scale dedicated plants, all small scale units practice the operations manually, with the aid of gadgets, such as, rotary brushes or tumbling devices in the washing operation. Grading, slicing/peeling are done manually. In case of pineapples, the slicing is done mechanically, while peeling is done manually. All unit operations are essentially adopted from practices and technology from abroad.

**Pulping:** The pulping operation or juice extraction operation varies significantly with the type of tropical fruit. In Mango, the prepared fruits are subjected to centrifugal pulping. The centrifugal force is applied on the fruit crushes and separates the pulp from seed and pomace, which is ejected directly, while the pulp passes through an appropriate strainer and discharged. In Guava, the fruits are crushed in the centrifugal pulper and received strained and separated from the pomace and skin. In Pineapple, the hydraulic press is the commonest practice for extraction of juice and is considered efficient in small scale operations. The use of continuous expression either by pinetronic machine (imported) is employed in some large scale units.

Apple processing which is mostly in the large scale sector uses the more sophisticated extraction process. Extraction of citrus juice is done in large scale units using the continuous citrus juice extractor, while the small scale units continue to use the rosing machines and hydraulic extractor. The rosing machine, which squeezes single fruit, is slow but produces juice wholly free from bitterness. The continuous screw press has higher inputs and is used generally in commercial small scale units to produce juice without a significant level of bitterness. The continuous screw press is considered an appropriate system and technology for the small scale sector. However, standardization of the process and pitch of the screw appropriate to the processing, need to be optimized.
**Straining / filtration:** Since the pulp produced often goes for production of squashes, syrups, jams or ready-to-serve beverages (juices), these are mostly subjected only to a coarse straining to remove any inadvertent inclusions or solid contaminants. In most cases, process used is a muslin cloth filtration or at best, a vibro screer. Further, in view of the end use, wherein certain amount of pulp content is desirable, fire filtration is not adopted. Fine filtrations are practiced only in cases where the juices free of any particulate materials are required for concentration of the juice by evaporative or membrane filtration techniques.

**Concentration:** Fruit processing industry, over the years, has attempted and adopted one or several of the following methods of concentration (to increase the total soluble solids in the product):

- Batch pan concentration
- Low temperature/vacuum evaporative concentration
- High temperature short time evaporative concentration
- Freeze concentration
- Reverse osmosis/micro filtration

Among these, the most widely used method in the small scale sector is the batch type, evaporation pan concentration. This method is characterized by suitability for viscous and non-viscous liquids, low investment, high power and steam consumption, low operating capacity and limited process control and hence, adversely affects product quality.

The technological improvements that need to be introduced and are adaptable by small scale sector relate to the introduction of low temperature vacuum concentration by using either falling film evaporation, forced circulation evaporation or scrapped surface evaporation, depending on the specific product needs. These systems and techniques are presently available and practiced in India in the large scale sector of fruit and vegetable processing industry.

**Canning:** Canning still continues to be the single most widely practiced process for long-term preservation of fruit pulps and juices. The continued use of canning process is due to factors such as, adaptability to the scale of operations, lower capital investment, versatility of the process to particulate and non-particulate products, pulps and juices and option of the extent of automation to individual processing units. While the unit operations in canning process have
been known and practiced for long in the small scale units, significant improvements in automation and process controls have been slow. The current technologies in canning include:

- Desecration of pulps/juice prior to canning
- Use of pressure compensated retorts
- Batch/continuous rotary can retorts
- On line monitor of process parameters

2.13.2 Frozen Fruits and Vegetables

Frozen fruit juices and pulps form a very large volume of trade in the international market. The attempt to use freezing as a technique of preservation has been practiced more in the preservation of vegetables than fruits. A limited volume of frozen mango and banana pulp has been attempted. It is considered that frozen fruit pulps can be a viable alternative to canning process for preservation. The process has technological advantage such as, adaptability to the small scale sector, versatility of the process to varied products and superior quality of final product. The inhibiting factor is the inadequate low temperature storage and transportation facility. The different technologies practiced in the freezing of fruits, vegetables or their products are:

1. Plate freezing/contact freezing: Freezing achieved by contact of the material with two refrigerated plates, typically used for fruits or vegetables in a pack.

2. Blast freezing: Used for high velocity low temperature air blast over the product in a chamber to freeze the product used for whole fruits, vegetables and products in package.

3. Tunnel freezer: Tunnel freezer is a modern variant of the blast freezer, wherein the low temperature air is blown through a tunnel, through which a belt/wire mesh conveyor carries the material to be frozen.

4. Fluidized bed freezing: Fluidized bed freezing is yet another variant of the principle of blast freezing, wherein the material on the belt or conveyor is held fluidized by low temperature air blast through the belt and the cold air surrounds the product. Since the product is individually quick frozen, it is also known as Individual Quick Freezing (IQF).
5. **Cryogenic freezing**: The material to be frozen is brought in contact with the refrigerant - liquid nitrogen or liquid carbon dioxide for instantaneous freezing.

The merits and demerits of the different processes of freezing and the adaptability to the scale of operations and economies of production are not the scope of this research work, so they are not included here.

2.13.3 Dried and Preserved Vegetables

Dehydration is probably the earliest practiced process of preservation of perishables. Dehydration, when applied to food, especially fruits and vegetables, is 'the process of removal of surplus water without destruction of cellular tissues or impairment of the energy values'. It is an operation in which 'water activity' of food is lowered by removal of nearly all the water normally present through vaporization or sublimation. In terms of unit operation, it is combination of mass and heat transfer. Based on these combinations, drying process and systems are of varied nature.

- Hot air drying, batch/continuous
- Drum drying
- Spray drying
- Fluidized bed drying
- Vacuum drying
- Freeze drying
- Osmotic dehydration
- Foam mat drying

1. **Hot air drying**: A process in which water is removed by passing hot air (60-65°C) on the product either as cross flow/through flow, kept in trays either in cabinet/continuous belt dryer.

2. **Drum drying**: This technique is mainly useful for drying a slurry by spreading the same in thin layer on the surface of a moving set of hot drums (93-176°C) and the dry leathery material is scrapped off, collected, powdered and packed.
3. **Spray drying**: It is a technique in which the concentrated slurry is atomized and sprayed in a spray dryer along with co-current/counter current of hot air and the dry end product is cyclone separated and packed.

4. **Fluidized bed drying**: This is a process in which material is dried in a current of hot air wherein the particulate product is fluidized to bring down the moisture level.

5. **Vacuum drying**: A process in which the removal of water is achieved under vacuum (low pressure).

6. **Freeze Drying**: A process in which the product is frozen below its eutectic point in the shortest time and the ice formed is sublimated below the melting point of water (initially) and gradually at (0-54 C.) at the end. The product is removed and packed in suitable unit containers.

7. **Osmotic dehydration**: Osmotic air dehydration is achieved by removing the water by a combination of osmotic pressure and drying.

8. **Foam mat drying**: The fruit pulp is mixed with a foaming agent and the product is whipped to obtain a stable form and then dried in cabinet dryer, e.g. banana and guava powder.

In the research paper “consumers’ attitudes towards high pressure freezing of food” the authors study whether consumers are ready to accept a new high pressure freezing method for food processing when different benefits are attached to the processing method. Consumer attitudes towards high pressure freezing were surveyed in The Netherlands, Belgium, Spain and Finland. It is found that generally, attitudes towards high pressure freezing were neutral, even though the term was unfamiliar for most consumers. When given some information about high pressure freezing technology, consumers considered applying this method as appropriate, especially if it had advantageous consequences to the product. Processing method itself was considered less important than price or environmental impact when the relative importance of choice criteria was studied with conjoint analysis. Practical implications of the research can be described as - not having to raise the price and possible environmental benefits seem to be the most crucial factors for promoting the acceptance of high pressure freezing as a new processing method in food.

processing. The paper shows that advantages of high pressure freezing technology, like decreasing the probability of microbial spoilage or improving the quality of products, had the clearest influence on consumers' appropriateness ratings.

2.13.4 Spice Products

The technologies related to spices and spice processing have not undergone any significant changes over the years.

Primary processing: Drying, Garbling, Grading

The primary processing in spices is essentially to prepare the product for storage and marketing by drying. Depending on the spice, different pre-treatment also is practiced, such as, boiling for turmeric, peeling and liming for ginger, curing for vanilla and saffron, bleaching for cardamom and coriander, retting for white pepper, etc. Commonly, drying follows the pre-treatment in the farm-households or primary assembling centers and sun-drying is the most widely practiced drying method. Technological interventions that can improve the market quality of whole spices are:

Black Pepper:  Blanching prior to drying - to improve the black color
Cardamom:  - Sulphur treatment for bleaching
            - Alkali treatment and controlled drying for retention of green color
Coriander:  Bleaching and drying

Ground Spices / Curry Powders

The general procedure for preparation of ground spices as practiced widely in the small scale sector of the industry is as follows in the table 2.7.
Table 2.7

General Procedure for Preparation of Ground Spices

<table>
<thead>
<tr>
<th>Unit Operation</th>
<th>Method</th>
<th>Technology Improvement Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying</td>
<td>Sun drying</td>
<td>Controlled drying</td>
</tr>
<tr>
<td>Grading / cleaning</td>
<td>Winnowing, Sieving</td>
<td>Pneumatic cleaning, magnetic separator</td>
</tr>
<tr>
<td>Grinding</td>
<td>Pin Mill / Plate Mill</td>
<td>Cold grinding, cryogenic grinding</td>
</tr>
<tr>
<td>Disinfection</td>
<td>Often not practiced</td>
<td>Fumigation with PH3</td>
</tr>
<tr>
<td>Packing and inert gas packing</td>
<td>-</td>
<td>Selection of packaging films and cartons</td>
</tr>
<tr>
<td>Blending (curry powder)</td>
<td>Manual</td>
<td>Mechanical devices like ribbon blending / cone blender</td>
</tr>
<tr>
<td>Roasting (curry powder)</td>
<td>Manual</td>
<td>Mechanical device with controls</td>
</tr>
</tbody>
</table>


Dehydrated green pepper

Dehydrated green pepper is produced from freshly harvested mature green pepper through a process of preliminary treatment and drying under controlled conditions. The conventional method of using sulphur dioxide for fixing of the color is obsolete. Currently, high temperature short-time treatment is used.

Spice Oils

Spice oils are the essential oil fraction of spices and quantitatively, the volatile oil ranges from 0.4% to 20.0% depending on the spice. The process adopted with certain variations, depending on the spice, consist of size reduction of spices, steam distillation of the spice, condensate oil water separation and drying and purification of oil. The technological improvements now available in the unit operations include stainless steel or glass lined steels, efficient condensers and oil water separators, drying systems.
Spice Oleoresins

The oleoresins of spices consist of an optimized blend of essential oil and the solvent extracted non-volatile fractions like pungent principles, fixatives, antioxidants and pigments. The volatile oil is distilled out from the ground spices. The wet powdered spice free from volatiles are dried and then extracted with suitable solvent systems to remove the fixed oil and resinous/gummy materials. The solvent is removed from the miscella, dried and the extract is mixed with dry spice oil to the required level and the product is suitably packed in containers.

The Technological improvements introduced successfully include mixture of solvents for extraction and fractionation of the oleoresins, and enrichment of specific fractions, such as, curcumin content in turmeric oleoresin, capsaicin enrichment or color enrichment of respective fractions in chilli oleoresin, piperine content in black pepper oleoresin.

Spice oils and oleoresins extracted by the supercritical carbon dioxide extraction are rated superior because of selective extraction of the aromatic constituents (volatile and non-volatile) rejecting the other constituents like waxes, sugars, pigments, proteins, etc. There is no solvent residue problem. Above the critical point, carbon dioxide exists as a supercritical fluid having distinctive solvent properties. It is an effective solvent for extraction of total oleoresin from spices, both essential oils and active principles. Oleoresin can be obtained using this fluid at temperature in excess of -70°C and high pressure between 90 and 300 bar.

The supercritical solvent flows into an extraction column, which contains substance to be extracted. The temperature and pressure are selected to obtain maximum solubility. The solute and solvent gaseous mixture leaves the extraction chamber and passes through an expansion valve where pressure is lowered. The solubility decreases with decrease in pressure and the extracted material precipitates. To precipitate the extract, depressurizing (retrograde condensation) is accomplished in the separator. The solvent from the separator is repressurised and recycled to extraction chamber. Although this approach is very expensive and requires very special and high pressure plant, it is considered ideal for processing of high cost materials like spices.
**Functionally improved spice products**

Though the spice extractives (oleoresins) provide the advantage of high concentration of active principles and consistency of products, they pose problems at the end-use level, such as, miscibility and dispersion in aqueous foods and slow release of the flavor. This generated the need and hence, the technology for derivatives designed for specialty needs. They include:

- Liquid soluble spices - Easily miscible formulations with aqueous products/Foods
- Spice emulsions - Stable emulsion - for use in oleous or aqueous products
- Spice concentrates - Concentrates of specific fractions of the spice extractives
- Encapsulated spices - Dry free flowing powders, protected by wall material which release the flavor only at the point of usage
- Dispersed spices - The active ingredients are dispersed in a medium or diluents for convenience of use with optimized flavor level - say table top dispensing.

2.14 **Prevailing Technologies - Life Cycle**

Technology for food processing and manufacturing is gathering its firm footings in last thirty years. Nonetheless, the growth rate has remained sluggish mainly due to consumer preference and the limited advancement in the horticulture field. Consumer demand for fresh food products has forced technologists to develop newer techniques and packaging materials.

2.14.1 **Fruit and Vegetable Products - Technologies**

Canning technology has developed into major industry, and the upgradation in the technology was seen during 1975-80 introducing HTST treatment of the fruit juices and concentrates. HTST and development of multi-layer laminates during 1982-83 brought in the concept of aseptic processing and packing. Newer techniques as an alternative to processing have been developed in 1990, e.g. high pressure sterilization, but as it is capital intensive, it finds a very limited application only.
2.14.2 Spices and Value Added Products - Technologies

Spices have been contributing to the growth of GDP and have received international recognition. Whole spices continue to be traded as a commodity, whose price is dictated by the market forces, irrespective of the quality improvement.

Value added spice products, like ground spices, spice oils, spice oleoresins, curry powders, spice blends, etc., have attracted the attention of the technologists worldwide. The technological development for this segment of food product in the last twenty years has been impressive. Earlier, spices used to be pulverized using hammer mills or the roller grinding with loss of the essential aromatic components.

In 1990s, cryogenic technology revolutionized the grinding technology, where the essential aromatic components were not only preserved in its totality, but also the grinding techniques. Having achieved the consumer needs for quality retention close to freshness, the innovation will continue to make the technology cost effective with quality improvement.

Solvent extraction for manufacturing spice oils and oleoresin was popular for more than forty years, but with advent of super critical extraction using liquid carbon dioxide, the solvent extraction will weather out in another ten years. The capital cost of super critical extraction is still not attractive to Indian companies.

In conclusion, the technology for food processing and manufacturing undergoes changes depending upon consumer expectations which itself is a slow process, on an average, taking about twenty years to make newer technology popular.

2.15 Future Outlook

In the research paper “Fast foods and ethical consumer value: a focus on McDonald’s and KFC” the authors aims to investigate the effect of communicating corporate social responsibility (CSR) initiatives to young consumers in the UK on their fast-food purchasing with reference to McDonald's and Kentucky Fried Chicken (KFC). Focus groups were conducted to

---

clarify themes and inform a questionnaire on fast-food purchasing behaviors and motives. Attitude statements were subjected to an exploratory factor analysis. Most respondents (82 per cent) regularly purchased fast food from one of the companies; purchases were mostly impulsive (57 per cent) or routine (26 per cent), suggesting relatively low-level involvement in each case. While there was skepticism regarding the CSR activity being promoted, expectations about socially responsible behavior by the companies were nevertheless high. Four factors were isolated, together explaining 52 per cent of the variance in fast-food purchasing behavior. They were brand value, nutritional value, ethical value and food quality. There are important implications for global fast-food companies in terms of protecting and developing their brand value; they need to respond to the wider food-related debates in society, in particular, those concerning healthy eating and food ethics. They also need to ensure that their business practices are fully consistent with the values expressed in their CSR initiatives.

In an article “Monitoring consumer confidence in food safety: an exploratory study”15 the authors aim to describe the development of a monitor that enables changes in consumer confidence in food safety and consumer food choice behavior to be assessed in conjunction with changes in institutional activities and food safety incidents. In response to the potential for negative economic and societal effects resulting from a low level of consumer confidence in food safety, it is important to know how confidence is potentially influenced by external events. A better understanding of the interrelationships between antecedents and behavioral consequences of changes in consumer confidence in food safety over time will improve understanding of the effectiveness of public policy, and allow the development of best practice in risk communication and risk management.

In another research paper “Information for good hygiene practice in small businesses”16 the authors discuss the Directive 93/43/EEC that introduced the concept of good hygiene practice, in response to a pan-European increase in the incidence of food poisoning, to foster a preventive approach to food safety. UK legislation reinforces the EL position that food businesses are


responsible for the implementation of good hygiene practices. The response of the food industry has been to develop audited standards of hygiene, higher than explicit legal requirements. Small businesses have, however, been slow to adopt industry hygiene standards. A case study of small manufacturers of ready to eat meat products investigated the reasons for this. Businesses were first audited to the EFSIS [1] standard, to compare current practice with recommended best practice. Second, technical managers or owner-managers were interviewed, to gain an insight into their knowledge of industry standards in particular, and the process of hygiene management in general. The analysis found significant differences in the knowledge of technical managers and owner-managers, with the latter often unaware of the existence of audited standards. It is argued, therefore, that, in order to increase the implementation of good hygiene practices, further programs to inform small food businesses about industry standards are required.

The groups of products having high domestic and export markets growth potential, such as, fruit juices, pulps and concentrates, frozen vegetables and dehydrated vegetables need special attention in equipping the sub-sector to face international competition. New outlets need to be discovered for products like fruit bars (mango, banana, guava, carrot, papaya, and jackfruit), fruit preserves, candies and glazed fruits like amla, ginger, papaya and banana. Markets, for banana figs, Osmo-dehydrated mango and pineapple slices, dehydrated fruits like pears, peaches, apples and vegetables like okra, beans, bitter gourd and many other items need to be explored.

The fruit juice market will develop further in the future and provide interesting outlets for fruit juice from developing countries, as, orange and other citrus juices in particular, are produced in large quantities and are well-accepted by consumers in most markets. Prospects for pineapple are expected to remain good, provided that a high quality product at reasonable prices can be regularly supplied.

2.15.1 Future Action Plan

The Technology Policy of the sector is discernible from the schemes and programs being operated and supported by the Ministry of Food Processing Industries, Government of India, towards:
• Development of infrastructure - commensurate with the present day requirement of technology;
• Facilitating modernization in specific identified sub-sectors;
• Updating packaging and storage technologies of all major processed foods;
• Developing technical manpower through establishing Food Processing Training Centers;
• Assisting and strengthening backward linkages of food processing industries.

Government has three major instruments - legal, fiscal and institutional - to support agro-processing and their promotion. Hence, policy initiatives encompassing these three avenues need to be in place on an urgent basis.

Institutional:
  o Create and empower an apex or central body Food Industries Development Authority
  o All sub-sector specific promotional and regulatory councils/agencies to be brought under the apex development authority

Legal:
  o Comprehensive legislation on food quality and safety standards to be formulated and administered by an apex regulatory authority

Fiscal: A mechanism of decentralization of providing fiscal incentives for:
  o Innovative technologies
  o Technology adoption/adaptation
  o Modernization of plant and systems
  o Technology insurance
  o Training and skill upgradation
  o Quality systems induction

There are no toxic waste generated by food processing industries, but the volume of the effluent and solid waste is large enough to manage. It is imperative that the treatment plants are installed; as otherwise, the volume of waste will cause concern not only to authorities but also to public for their safety and hygienic environment.
Importantly, treated wastes, do generate income if properly handled to give economic return on the capital invested. For this, support needs to be provided to the industry towards internalizing and recycling of waste materials right from the benchmark scale. Awareness campaign should be made to educate entrepreneurs to adopt safety, health and environmental standards. Efforts should be made to establish clusters or agro parks with common facilities like waste treatment, testing labs etc.

A common platform for the industry should be immediately established with the support of SIDBI, CFTRI, CII and industry associations to monitor the growth, voice grievances, suggest remedial measures and guide the entrepreneurs.

In a research paper "Australian farmers' and food processors' values"\(^{17}\) the authors aim in the exploratory study to examine and compare a range of business values held by farmers and food processors. Questionnaires with a section on business values were posted to 200 farmers and 200 food processing businesses in Victoria, Australia, with response rates of 44 per cent \((n=89)\) and 31 per cent \((n=48)\), respectively, achieved. The most important of the 28 value items for farmers were high quality produce, honesty, and caring for employees. For processors, the most important values were quality products, customer value, and caring for employees. Between group differences reached statistical significance for one-third of the items. In particular, processor businesses valued innovation and convenience products more highly and had a stronger process orientation than did farming businesses. Environmental sustainability, caring for the community, and providing healthy products were more integral to farming than processing businesses. This information could increase the effectiveness of communications with industry groups on a range of issues and in the formulation of appropriate health and environmental policies.

2.16 Chapter References


“The Impact of Food Safety and Agricultural Health Standards on Developing Country Exports”. Poverty Reduction and Economic Management Trade Unit, and Agricultural & Rural Development Department, 10 January 2005.


Jaffee, Steven M. “Trade Note on Food Safety and Agricultural Health Standards and Developing Country Exports: Rethinking the Impacts and the Policy Agenda”. International Trade Department, the World Bank Group, 2006.


**Websites:**

www.manage.gov.in (25 October 2007)

www.mofpi.nic.in (26 October 2007)

www.sidbi.in (27 October 2007)

www.ipcnet.org (28 October 2007)


www.indianspices.com (31 October 2007)

www.itcot.com (02 November 2007)

www.cijonline.org (05 November 2007)

www.fao.org (06 November 2007)

www.horticultureresearch.net (07 November 2007)

www.worldbank.org (08 November 2007)

www.thehindubusinessline.com (09 November 2007)

www.kat-group.com (10 November 2007)

www.icrier.org (12 November 2007)

www.cseindia.org (14 November 2007)

www.adb.org (15 November 2007)

www.online.sagepub.com (25 October 2008)

www.emeraldinsight.com (01 November 2008)