

groups:

1. Acid-resistant clear lacquers,
2. Sulphur-resistant lacquers,
3. Double-coated meat lacquers,
4. Phenolic meat lacquers,
5. Lacquers for deep drawing.

Recently a sulphur-resistant lacquer known as "corn enamel" has been introduced.

Preservation of fruits and vegetables using chemical preservatives has been practised in European countries since long. At present, only sulphur dioxide and sulphites and benzoic acid and some of its esters are permitted in foods. Sorbic acid and sorbates are permitted only in some cases. Antibiotics such as nisin, tylosin, etc., are still under consideration. A number of other chemicals, e.g., formaldehyde, salicylic acid and boric acid, which were earlier used as preservatives, have now been prohibited.

In India, the first fruit and vegetable processing factory was established in 1935 at Bombay which was followed by the setting up of units in Madras, Calcutta, Uttar Pradesh, and the Punjab. In 1950, the Central Food Technological Research Institute was established at Mysore, to promote the food processing industry and conduct research on various problems associated with foods. Its seven regional centres are located in Bangalore, Nagpur, Hyderabad, Lucknow, Ludhiana, Jammu and Trivandrum.

In order to control the quality of processed food the Government of India in 1955 passed the Fruit Products Order (F.P.O., 1955) according to which a licence is necessary for commercial manufacture of food products. Home scale processing does not require a licence. For licensing, a Food and Nutrition Board was established in 1973.

Government of India has also established a National Horticulture Board, Gurgaon (Haryana) for increasing the production of fruits and vegetables and their preservation to reduce post-harvest losses.

A Fruit Preservation and Canning Institute was established at Lucknow in 1949 by the Government of U.P. with the following objectives:

- (i) To promote the development of fruit and vegetable processing industry.
- (ii) To conduct research on problems associated with post-harvest and processing technology of fruits and vegetables.

(a) **Establishment of community canning centres:** These have been set up at every divisional headquarters in the State and in every important district. It is hoped that such centres will start functioning soon in other places also. These centres give technical advice regarding preservation and provide facilities to private individuals for canning and bottling of their raw material using latest equipment, not available in homes.

(b) **Training:** Several types of training courses have been started. At every divisional headquarters and in important community canning centres there is a team of a lady instructor and assistant instructors to impart training exclusively to ladies. Such teams can also go to other places in the State on request. The duration of training, theoretical and practical, for preparing products for home consumption, is three weeks.

A post-graduate diploma course of 18 months duration (to be increased to 2 years) was started at the Government Fruit Preservation and Canning Institute, Lucknow. The course includes 3 months factory training.

The same type of training is also given at the Central Food Technological Research Institute, Mysore. Some agricultural universities have started departments of horticulture, with fruit technology as a major subject, to promote this discipline.

(c) **Research:** At various research institutions all over the country attempts are being made to evolve better and more economic methods of preservation of fruits and vegetables under Indian conditions.

(d) **Commercial production :** The U.P. Government has established food preservation and canning factories for commercial processing of fruits and vegetables on scientific lines. The products are sold at reasonable prices.

Fruit and vegetable processing is one of the most important agro-based industries. Owing to its seasonal and perishable nature, processing assumes a special significance. Fruit and vegetable processing play the role of siphoning off the seasonal gluts and surpluses of production and thereby help impart stability in prices. the industry is labour-intensive and offers high employment potential both at the farms and in the factories. The Government has already recognized fruit and vegetable products as one of the major thrust areas for augmenting the country's exports. Among fruits, mainly mango, pineapple, citrus and among vegetables, mainly tomato, onions, peas, okra and potatoes, are regularly processed. The fruit and vegetable processing industry in India in the organized sector is comparatively a recent phenomenon. The industry is highly decentralized with a majority of units being in the cottage/small sector. The majority of the units is in the private sector (95 per cent), the balance is among the public and coopera-

- (iv) Package made of EVOH is excellent for the retention of fragrance and aroma of the contents over a long shelf-life period.
- (v) Coextruded films and sheets can be thermoformed, vacuum and pressure moulded.
- (vi) They possess a high gloss and low haze resulting in outstanding clarity.
- (vii) EVOH can be easily processed on conventional processing equipment.

(9) Polyvinylidene chloride

Polyvinylidene chloride (PVDC) resins are copolymers containing at least 50% vinylidene chloride. More than 90% of the world production is used in food and medical packaging.

The properties of PVDC film include low permeability to atmospheric gases, moisture and most flavour and aroma bodies, stress-crack resistance to a wide variety of agents, ability to withstand the rigours of hot filling and retorting. The major uses are for coating and film applications.

(10) Ionomers

The term ionomer was coined to describe a family of polymers in which there are ionic forces between the polymer chains, in addition to the normal covalent (chemical) bonds between the separate atoms in each chain. Ionomers are basically copolymers of ethylene and methacrylic acid, with some of the acid groups present in the form of a metal salt. The polymerization process is again similar to that of LDPE. Ionomers are made by Du Pont under the trade name 'Surlin'.

At room temperature, ionomers have greater resistance to oils and greases than LDPE, although the differences are not so marked at elevated temperatures. Resistance to environmental stress cracking is good and is said to be higher than that of LDPE. Ionomers are resistant to weak and strong alkalis but are slowly attacked by acids. Other chemical properties of ionomers are similar to those of LDPE. Gas permeability is similar to that of LDPE but water vapour permeability is somewhat higher as is water absorption.

Ionomers also have exceptional toughness characteristics, as evidenced by their level of resistance to abrasion, puncture and tear. Film toughness is a key requirement for cavity-formed packaging as this property, along with adequate film thickness, imparts flex-crack resistance to package corners. Package sparkle and clarity, and adhesion to polar substrates in the presence of aggressive environments are additional properties offered by ionomers.

Food Colours

The acceptance of a food depends to a large extent upon its attractive colour. The characteristic colour of raw food is due to the pigments naturally present in it. Sometimes, artificial colour is added during the preparation and processing of foods to make them more attractive.

(A) Natural colouring matters

The natural colours (pigments) in vegetables and fruits can be classified on the basis of chemical structure as carotenoids (yellow-orange), chlorophylls (green), flavonoids and anthocyanins (red, blue and purple) and anthoxanthins (cream yellow).

The following pigments are present, singly or in combination, in plant-based foods.

1. **Chlorophylls** : These green coloured, fat-soluble pigments, involved in photosynthesis, are present in many plants specially in leafy vegetables such as cabbage and lettuce. There are two types of chlorophyll, a and b, which occur in plants in the ratio of 3:1. They are related to the porphyrins, an important group of biological pigments which includes haemoglobin. There is always some deterioration of chlorophylls on storage, whatever the processing method used.
2. **Carotenoids** : Carotenoids are fat-soluble, orange-yellow pigments that are present in many vegetables and fruits such as carrot, pumpkin, mango and orange. The first carotenoid isolated was from carrot and, therefore, was named carotene. Its concentration in a vegetable is indicated by the intensity of the colour.

The most widely distributed carotenoids are lutein, violaxanthin, and neoxanthin which found in green leaves. Carotene and zeaxanthin also occur widely but in small quantities. Some pigments predominate in certain plants like lycopene in tomato, capsanthin in red pepper and xixin in annatto.

Carotenoids are also present in most green leafy vegetables along with chlorophyll but their colour is masked by the green of chlorophyll. The fresh

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