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## **New employment opportunities in fibre and food processing industries in Pakistan**

**By Mrs. Farzana Panhwar, January 19th, 2005**

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## **NEW EMPLOYMENT OPPORTUNITIES IN FIBRE AND FOOD PROCESSING INDUSTRIES IN PAKISTAN**

### **Abstract.**

During 1994-95, the area under cropping including food grain, cash crops, fruits and vegetables in Pakistan was 22.14 million hectares. The area under all fruit crops was 0.57 million hectares, although area under fruit crops in Sindh during 1994-95 was 91,200 hectares, which produced, 439,000 tones of fruits. the losses during the harvest of fruits in the field amount to 10% or more losses between harvest to consumption is account for another of about 40% , thus the total losses could be as high as 50% of the produce.

Food processing techniques are used for reducing the food borne diseases, attack of micro-organisms and to protect the health of consumers.

In Pakistan we have a number of food processing industries like: and non-alcoholic beverages, cereals and baked goods, cheese and cheese spreads, candies and confectionery, cooking fat, oil, salad oil and shortening, egg products, fermented food, fish and marine products, fruits, jam, jellies, red meat and poultry products, sugar, syrup and corn starch and vegetables industries.

In food industries we use various industrial fermentations like, lactic acid bacteria, acetic acid bacteria, yeast with lactic and acetic acid bacteria.

Some times irradiation, heat preservation and dehydration techniques are also used for processing and preservation purposes.

Our food is mostly contaminated with pesticides and micro-organisms so we need to take help of highly sophisticated automated computerised techniques for their removal and studying.

In order to get better fruits and vegetables, scientists are taking the help of growth regulator, genetic engineering and biotechnology for evolving crops with particular better ability of processing character of colour, flavour, texture and nutritive value which will boost the processing industries.

If we take care of processes industries it will bring income and employment in rural and urban areas of Pakistan.

### **Introduction.**

Food processing techniques are used for reducing the food borne diseases, attack of micro-organisms and to protect the health of consumers. The goal of food processing is to control the perishable foods, and preserve in a stable form which can be stored, and shipped to distant markets all year round.

**Food micro-organisms spoilage associations are as under:**

Class of food product.	Genera dominating when spoilage occurs during standard conditions of storage
Milk and milk products.	Streptococcus, Lactobacillus, Microbacterium. Gram - ve rods Bacillus.
Fresh meat.	Gram - ve rods, Micrococcus; Cladosporium, Thamnidium.
Poultry.	Gram - ve rods, Micrococcus.
Sausage, beef, mutton etc.	Micrococcus, Lactobacillus, Streptococcus, Debaryamyces, Penicillium.
Fish, shrimps, shellfish.	Gram - ve rods, Micrococcus.
Eggs.	Pseudomonas, Cladosporium, Penicillium, Sporotrichum.
Vegetables.	Gram - ve rods, Lactobacillus, Bacillus.
Fruits and juices.	Acetobacter, Lactobacillus, Saccharomyces, Torulopsis, Botrytis.
Cereal grains.	Aspergillus, Fusarium, Monilia, Penicillium, Rhizopus.
Bread.	Bacillus, Aspergillus, Endomyces, Neurospora, Rhizopus.

**Chemicals used by food industries to prolong storage life of fresh fruits and vegetables.**

Function	Chemicals used	Fruits and vegetables
Inhibit micro-organisms.	Sulphur dioxide.	Stone fruit, strawberry, citrus and grape.
	Sodium bisulfite.	Grape.
	Sulphur.	Peach.
	Thiourea.	Orange.
	Zinc salt of pyridine-N-oxide-2-thione.	Peach.
	Thiobendazole.	Pear.
	Biphenyl.	Citrus, grape, peach, potato.
	8-Hydroxyquinoline.	Strawberry.
	Sodium salicylanilide.	Banana, orange.
	Ammonia.	Citrus, peach.
	2-Aminobutane.	Citrus, apple, peach.
	Captan.	Strawberry, cherry, pear.
	2, 7-dichloro-4-nitroaniline.	Sweet cherry, peach.
Reduce weight loss.	Benomyl.	Green vegetables.
	N <sup>6</sup> -benzyladenine.	Green vegetables.
Inhibit sprouting.	Naphthalene ethanoic acid.	Cauliflower, cabbage.
	Maleic hydrazide.	Onion, radish, tuurnip, carrot potato.
Reduce leaf abscission.	Isopropyl-N-(3-chlorophenyl) carbamate.	Potato.
	Naphthalene ethanoic acid.	Cauliflower, cabbage.

### Methods to maintain good qualities for processing of condition.

- Harvest at optimum maturity of quality.
- Handle rapidly and deliver to processing plants as quickly as possible.
- Pre-cool, to remove field heat and prevent heating.
- Provide high relative humidity to minimise moisture loss.
- Handle carefully to avoid any kind of mechanical injury.
- Provide protective containers or packages during Handling.
- Enforce good plant sanitation procedures.

Various factors effects on processing are as under:

- Physiological state of the cells of agricultural commodities.
- Rate of cooling and drying during processing.
- Suspending medium used during processing stages.
- Time held for frozen stage.
- Rate of warming for killing the micro-organisms.
- Planting medium for the operation.

After the harvesting food processing in the form of quality control begin, while other factors like handling, time, temperature and storage are, also responsible for quality maintenance. The various stages of food processing include. Drying fruits and vegetables; washing, sorting, peeling, pit, core, slicing (Pre-treat) like fruits e.g., sulphur or dip, vegetables; blanched in steam or water, (dried oven, sun, dehydration, condition, pasteurisation, packaging and storage stages. The preservation processing consist of canning, freezing, dehydration, salting, pickling, freezing and drying. Food processing can change foods in to new or more usable form and make foods more convenient to prepare.

Chemicals used in food industries, during and after harvest of fruit and vegetables to increase shelf-life, improve nutrition, firmness, appearance and control weight loss.

Function	Chemicals used	Fruit and vegetables
Delay ripening.	Gibberellic acid.	Tomato, guava, banana, lemon, orange
	Maleic hyrazide.	Mangto, tomato.
	Cycloheximide	Pear.
	Vitamin K.	Banana.
	Maleic acid.	Banana, citrus.
	Ethylene oxide.	Mango, tomato.
	Sodium dehydroacetate.	Strawberry.
	Potassium permanganate.	Banana.

Function	Chemicals used	Fruit and vegetables
Hasten ripening.	Ethephon and ethylene.	Tomato, cantaloupe, fig, peppers, banana, citrus.
	Abscisic acid.	Orange, banana
	Ethyne.	Banana, tomato, lemon, orange.
	Oil.	Fig.
	2,4-D.	Banana, guava.
Reduce weight loss.	Chlorophenoxy acetic acid	Mandarin orange, bean
	-Naphthoxyacetic acid	Mandarin orange
Decrease loss of vitamin C.	Gibberellic acid	Citrus.
	Ghlorophenoxy acetic acid -Naphthoxyacetic acid	Mandarin orange
Retain green colour.	Chlorophenoxy acetic acid	Bean.
	2, 4-D	Green vegetables.
	Cyocel.	Lettuce.
	Cycloheximide.	Pear.
Control firmness.	Gibberellic acid	Citrus.
	Alar.	Apple.
	Ethylene oxide.	Mango.

**Chemicals used in process foods industries. These are as under:**

Purpose	Chemical	Function	Food Industries
Preserve quality.	Propionates.	Retard moulds.	Cheese, backed goods.
	Sodium benzoate.	Retard bacteria, yeasts.	Soft drinks, acid foods.
	Sorbic acid, potassium sorbate.	Retard moulds, yeasts.	Acid foods, cheese.
	Sulphur dioxide.	Retard all micro-organisms, browning.	Dried fruit, fruit slices, grapes.
	Ethanoic acid (including vinegar), acetates.	Retard bacteria, yeasts.	Acid foods, baked goods.
	Sucrose.	Inhibit micro-organisms.	Jam, jelly.

Purpose	Chemical	Function	Food Industries
	Carbonyls, organic acids.	Retard micro-organisms.	Fish, meats.
	Esters of p-hydroxybenzoic acid.	Retard moulds, yeasts.	Beverages, artificially sweetened jelly.
	Nitrite (future use under study)	Inhibit botulinum growth	Cured meats.
	Sodium chloride (salt)	Control micro-organisms, retard enzymatic browning.	Fish, meat, pickles, fruit slices.
Stabilise or improve nutritional content.	Butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), -tocopherol.	Stabilise vitamin A, inhibit oxidation.	Fish products, sausages, potato chips, nut meats.
	EDTA, citric acid, sulphur dioxide.	Stabilise vitamin C	Black current juice, beverages.
	Sodium chloride(salt)	Retain water-soluble nutrients.	Frozen fish.
Stabilise or improve texture.	Calcium compounds	Increase firmness	Canned and frozen fruits and vegetables.
	Rennin.	Coagulate casein	Cheese.
	Papain.	Tenderise.	Meat.
	Sodium hexametaphosphate.	Soften texture.	Canned peas, beans, meat,, poultry.
Stabilise or improve colour or appearance.	Sulphur dioxide.	Prevent browning.	Dried fruits, potatoes.
	Ascorbic acid.	Prevent enzymatic browning.	Frozen fruit slices.
	Sodium chloride.	Prevent enzymatic browning.	Apple slices.
	Sucrose.	Prevent enzymatic browning.	Fruit slices.
	Citric acid and malic acid.	Retard browning.	Fruit slices.
	EDTA (disodium)	Prevent discoloration by inactivation of trace metals.	Potatoes, corn.
	Beet powder.	Provide red colour.	Various foods.
	Annatto.	Provide yellow colour.	Oleo-margarines, shortening.
	Nitrites (future use under study).	Alter and fix colour.	Meats.

Purpose	Chemical	Function	Food Industries
	Polyvinylpyrrolidone.	Clarify.	Beverage, vinegar.
	Pectinase.	Clarify.	Fruit juices.
Stabilise or improve texture.	Sodium acid pyrophosphate	Leaven	Bakery products.
	Polyoxethylene sorbitan esters.	Emulsify.	Ice cream, cake mixes, shortening.
	Glycerol.	Promote water retention.	General use.
	Calcium silicate.	Prevent caking.	Salt, baking powder.
Stabilis: or improve flavour.	Ascorbic acid	Prevent oxidation.	Canned foods.
	BHA, BHT, propylgallate, tocopherol.	Prevent oxidation and browning.	Potato granules, nut meats, diced meats.
	Citric acid.	Prevent oxidation.	Canned fruits and vegetables.
	Triethyl citrate.	Chelate metals and lessen oxidation.	Egg white.
	Citrates of calcium or potassium.	Chelate metals and lessen oxidation.	Oils, fats, salad dressing.
	Organic acids.	Enhance flavour.	Carbonated beverages.
	Sodium chloride.	Enhance flavour, retard browning.	General use, cut fruits.
	Synthetic flavours.	Enhance flavour.	General use.
	Sweeteners.	Enhance flavour.	General use.
	Lecithin.	Enhance flavour.	Oleomargarine, shortening candies.
	Monosodium glutamate.	Enhance flavour.	General use.
	Monsodium glutamate.	Enhance flavour.	General use.
Maltol.	Enhance flavour.	Soft drinks.	

#### Food preservation is used to tackle the following tasks.

- The control of micro-organisms.
- To control chemical changes.
- To maintain the nutritive value, colour, flavour, texture and composition.

The following natural colouring principles, whether isolated from natural colours or produced synthetically, may be used in or upon any Fruit Products.

- (a) Cochineal or carmine.
- (b) Carotene and carotenoids.
- (c) Chlorophyll.
- (d) Lactoflavin.
- (e) Caramel.
- (f) Annatto.
- (g) Ratanjot.
- (h) Saffron.
- (i) Curcumin.

**Citric acid use in process industries.**

Industry	Uses
Beverage.	As flavour enhancer as preservative. Eliminates have due to trace metals: prevents colour and flavour deterioration.
	In wines - prevents turgidity: inhibits oxidation: adjusts pH.
	In soft drinks - gives a cool taste: maintains carbonation.
Food and candy.	In confectioners - enhances flavour, inverts sucrose, prevents oxidation. Produces darker colours in hard candies, jams, and jellies and adjusts pH.
	In frozen foods - neutralise residual lye: protects ascorbic acid from oxidation inactivates trace metals. Inactivates oxidative enzymes by lowering the pH to prevent change in colour and flavour.
	In dairy products-acts as an antioxidant and as emulsifier in cheese ice cream etc.

**Technical effects of food additives.**

TECHNICAL EFFECT	TYPICAL ADDITIVES IN CURRENT USE TO ACHIEVE THESE EFFECTS
Anticaking agents, free-flow agents, keep seasoning salts and other mixes from turning into a solid chunk, during damp weather.	Calcium stearate, cornstarch, sodium aluminosilicate, tricalcium phosphate, calcium silicate, magnesium carbonate, silica aerogel.
Antigushing agents prevent the beer or other carbonated beverage from "gushing" from the container when it is first opened.	None now known to be in use.
Antioxidants include substances that keep edible fats and oils from turning rancid and others that prevent cut fruits and vegetables from turning brown.	BHA, BHT, ascorbic acid (Vitamin C), ethoxyquin.

TECHNICAL EFFECT	TYPICAL ADDITIVES IN CURRENT USE TO ACHIEVE THESE EFFECTS
Boiler water additives are chemicals added to boiler feed water to prevent scale from forming as a result of the hardness of the water, when steam from the boiler is used in food processing, small amounts may be carried over into the final food.	Acrylamide-sodium acrylate resin, polyethylene glycol, sodium tripolyphosphate, morpholine.
Clouding and crystallising agents and inhibitors.	Methyl glucoside-coconut oil ester, oxystearin
Colours, colouring adjuncts (including colour stabilisers, colour fixatives, colour-retention agents, etc.) consist of synthetic colours, synthesised colours that also occur naturally and other colours from natural sources.	FD&C Blue No.1, FD&C Red No.3, and other certified synthetic colours; B-carotene; iron oxide and other exempt synthetic colours; beet powder, grape skin extract caramel, turmeric, and other natural colours.
Compounds in the manufacture of other food additives are substances that perform no function in the final food but are necessary in the manufacture of some other additive, and traces of which may survive into the final food; it is an un-international "additive in an additive".	Any common inorganic compounds, such as sodium hydroxide, sulphuric acid, food colour intermediates, synthetic fatty alcohol
Curing, pickling agents preserve (cure) meats, give them desirable colour and flavour, discourage the growth of micro-organisms, and prevent toxin formation.	Sodium nitrate, sodium nitrite, salt, sodium metaphosphate, sodium tripolyphosphate; sodium erythorbate, ascorbic acid.
Dough conditioners, strenghters are both simple chemicals and also enzymes which modify the protein and cellulose in such a way as to reduce the "toughness" or "springiness" of dough and make it both easier to handle and more appealing to consume.	Potassium bromate, acetone peroxide, calcium sulphate, glyceryl monostearate, ammonium sulphate, monocalcium phosphate, locust (carob) bean gum.
Drying agents are intended to absorb moisture from other food components.	Specially dried cornstarch, anhydrous dextrose
Emulsifiers are an important group of substances used to obtain stable mixture of liquids that otherwise would not mix or would separate quickly.	Mono and diglycerides; lecithin; propylene glycol monostearate; sorbitan monostearate; polysorbates 60, 65, and 80.
Enzymes are complex proteins which promote almost all the chemical reactions that occur in all living things; some of these can be adapted to specific processing needs.	Rennet for producing cheese curd, papain for tenderising meat, pectinase for clarifying beverages.
Fermentation aid, malting aid are yeast nutrients and other substances that promote rapid and proper fermentation.	Gibberellic acid, potassium gibberellate, potassium bromate.
Flavour enhancers do not themselves contribute significant flavours but increase the effect of certain kinds of other flavours.	Soy sauce, MSG, disodium inosinate, disodium guanylate.

TECHNICAL EFFECT	TYPICAL ADDITIVES IN CURRENT USE TO ACHIEVE THESE EFFECTS
Flavouring agents, adjuvants are the ingredients, both naturally occurring and added, which give the characteristic flavour to almost all the foods in our diet; flavour adjutants are substances not themselves flavours, which improve the usefulness of flavours, such as solvents and fixatives.	Many of the traditional spices and herbs plus nearly 1500 individual chemical entities, most of which have been identified as the constituents responsible for the flavour of natural food products.
Flour-treating agents (including bleaching and maturing agents) usually both leach and "mature" the flour, i.e., they provide the same effect as increased age. They oxidise some of the proteins and lead to better handling characteristics and larger loaf volume.	Acetone peroxide, benzoyl peroxide, azodicarbonamide, potassium bromide.
Formation aids cover a hodgepodge of substances which simply allow foods to be put together in a useful way with retention of quality during transportation and storage.	Carrier solvents for dissolving and standardising flavours, starch as a binder, modified starch, gum acacia, magnesium stearate, sodium caseinate, mannitol, propylene glycol, corn syrup, dextrose.
Freezing agents are extremely volatile liquids - gases at ordinary temperatures and pressure - which evaporate rapidly and chill the food exposed to the cold vapor.	Liquid nitrogen, dichlorodifluoromethane
Fumigants kill undesirable organisms.	Methyl bromide, ethylene oxide, phostoxir
Humectants, moisture-retention agents, and antidusting agents retain the texture of food by preventing it from drying out.	Sorbitol, propylene glycol, sodium tripolyphosphate.
Ion-exchange resins are long, insoluble molecules (polymers) which have an affinity for certain positively or negatively charged ions, and which can be used to remove these ions from water or a solution or juice.	A long list of resins, including acrylate-acrylamide resins, sulfonated copolymer of styrene and divinyl benzene, sulfonatedanthracite coa, sulphite modified cross-linked phenol-formaldehyde, etc.
Leavening agents produce light, fluffy backed goods.	Yeast, monocalcium phosphate, sodium aluminium phosphate, sodium acid phosphate, sodium carbonate, calcium carbonate and other baking powder ingredients.
Lubricants, release agents allow the extrusion of foods and rapid, economical production of bread by permitting it to come cleanly out of the baking pan.	Oleic acid, hydrogenated sperm oil, mineral oil.
Masticatory substances for chewing gum give the bulk, plasticity, and resistance required for proper mouth feel.	Chile, rubber, paraffin, glycerol esters of rosin.

TECHNICAL EFFECT	TYPICAL ADDITIVES IN CURRENT USE TO ACHIEVE THESE EFFECTS
Nonnutritive sweeteners having less than 2 percent of the caloric value of sucrose per equivalent unit of sweetening capacity, replace sugar or corn syrup in dietetic foods.	Saccharin, cyclamate (in many countries).
Nutrient supplements restore values lost in processing or storage or insure higher nutritional value than nature may have provided.	All the known essential nutrients such as vitamin A and other vitamins, iron and other trace minerals, amino acids and essential fatty acids.
Nutritive sweeteners are any digestible sweeteners yielding more than 2 calories per gram.	Dextrose, fructose, sucrose, corn syrup, molasses, honey.
Oxidizing and reducing agents perform these chemical operation on food components to get rid of an undesirable component or contaminant.	Peroxidase (enzyme) to destroy glucose in dried egg, so that it will store well; hydrogen peroxide added as a bleaching or anti-microbial agent.
PH control agents (including buffers, acids, alkalis, neutralising agents) reduce or increase the acidity or sources of a food.	Vinegar (acetic acid), sodium bicarbonate, hydrogen chloride, citric acid sulphuric acid, sodium citrate, sodium hydroxide, adipic acid.
Preservations, anti-microbial agents prevent bacteriological spoilage.	Sodium benzoate, calcium propionate, potassium sorbate.
Processing aids are added, not for the continuing effect they exert on the food, but to help make it better in the first place, for example, by aiding filtration or removing unwanted colour.	Charcoal, diatomaceous earth, hydrochloric acid, papain, polyvinylpyrrolidone, dioctyl sodium sulfosuccinate.
Propellants aerating agents, gases push the whipped cream topping from the can and make it fluffy, or exclude oxygen and prolong the shelf life and nutritional value of a packaged food.	Chlorinated, fluorinated hydrocarbons; carbon dioxide; nitrous oxide; nitrogen; combustion gases
Sequestrates combine chemically with traces of metals present naturally in all foods, which if uncombined, would promote instability and off-flavours.	Citric acid, EDTA, phosphoric acid, sodium metaphosphate
Solvents, vehicles dissolve or suspend flavours, colours, and many other ingredients in an easy-to-use form.	Alcohol, propylene glycol, glycerine, triethyl citrate, triacetin, acetone
Stabilisers, thickeners give desirable viscosity and mouth feel, prevent emulsions from separating and prevent a pudding from being "sloppy".	Starch, modified food starches; natural and synthetic gums, such as guar, acacia, carragenan, carob bean.
Surface-active agents are related to the emulsifiers and permit rapid wetting of dry ingredients and better whipping of toppings; they promote foam where it is wanted or prevent it where it is not.	Dioctyl sodium sulfosuccinate, sodium lauryl sulfate, lactic esters of fatty acids, dimethyl polysiloxane

TECHNICAL EFFECT	TYPICAL ADDITIVES IN CURRENT USE TO ACHIEVE THESE EFFECTS
Surface finishing agents are used on fruits, candies, and baked foods both for protection and appearance.	Beeswax, carnauba wax, gum acacia, sheltac wax, rice bran wax, oxidized polyethylene, rosin, polyvinylpyrrolidone.
Synergists is a catch-all category of substances which produce no particular effect in themselves but help those of other additives.	Citric acid, tricalcium phosphate, and other phosphates.
Texturizers contribute or preserve desirable appearance or mouth feel; e.g., a smooth, silk sauce or pudding produced with normal starch is often less attractive than one with a somewhat pulpy appearance and feel produced by modified starches.	Sodium bicarbonate, glycerine, corn syrup, modified food starch.
Washing-peeling aids, vegetable clearing agents are substances that soften or dissolve the peel of a fruit or vegetable or that soften or loosen dirt; they save hand labour by making mechanical peeling and washing more effective, and they waste less food than hand processing.	Sodium hydroxide (lye), sodium metasilicate, aliphatic acids, sodium hypochlorite, sodium nalkylbenzene sulfonate, odourless light petroleum hydrocarbons.

### Fermentation technology.

Fermented food derived from cereals, oil seeds and prepare beer, soy sauces, tofu and variety of other oriental foods. Both spoilage and deterioration problems are encountered by this method. Fermentation is initiated by low alcohol tolerant yeasts e.g., *Hanseniaspora guillermondi*, *Kloeckers apiculata*, *Torulopsis* and *Candida* species. These are later over-taken by more alcohol tolerant *Saccharomyces* yeast. Yeast and mold could be controlled by pasteurising, cooling washing, peeling and better storage techniques. Fermentation a caused by bacteria or adoptive yeast is found in bakery, sauces, starch based salad and dressing. Pasteurised condition in the packaging stage are helpful in controlling such bacterial and micro-organisms attack.

### Bacterial genera used in the fermentation industry, including representative species.

RODS		
Rhizobium	rods, Gram - serobic, fix N <sub>2</sub> in symbiosis with legumes.	R. leguminosarum
Esherichia.	Rods, Gram - aerobic and facultatively anaerobic, indicator of fecal contamination, enzyme producer.	E. coli
Salmonella	rods, Gram - aerobic and facultatively anaerobic, food pathogen.	S. typhimurium
Azotobacter	rods, Gram - aerobic, fixes N <sub>2</sub> non-symbiotically.	A. agilis
Alkaligenes	rods, Gram -, some facultative anaerobes, litmus milk is turned strongly alkaline.	A. faecalis

<b>RODS</b>		
Pseudomonas	rods, Gram -, highly aerobic, motile, the pseudomonads have some auxotrophic members, e.g., "Methanomonas".	P. fluorescens
Acetobacter	rods, Gram -, highly aerobic, forms acetic acid.	A. aceti
Brevibacterium	rods, Gram +, aerobic, reddish to brown pigment.	B. linens
Cellulomonas	rods, Gram +, aerobic, decomposes cellulose.	C. thermocellum
Corynebacterium	rods, Gram +, aerobic.	C. glutamicum
Lactobacillus	rods, Gram +, anaerobic, homo-fermentative or heterofermentative producer of lactic acid.	L. casei
Propionibacterium	rods, Gram +, anaerobic, produces propionic acid.	P. shermanii
Bacillus	rods, Gram +, aerobic and facultatively anaerobic, sporeforming, highly diverse group.	B. subtilis
Clotridium	rods, Gram +, sporeforming, anaerobic, cellulose fermenters are Gram.	C. butyricum
<b>COCCI</b>		
Streptococcus	cocci, Gram +, microaerophilic, non-sporeforming, lactic acid producer.	S. lactis
Pediococcus	cocci, Gram +, microaerophilic, nonsporeforming, lactic acid producer.	P. cerevisiae
Leuconostoc	cocci, Gram +, microaerophilic, nonsporeforming, lactic acid producer.	L. citrovorum
Staphylococcus	cocci, Gram +, microaerophilic, nonsporeforming, pathogenic, and a food poisoning organism (enterotoxin).	S. aureus
<b>ACTINO-MYCETES</b>		
Streptomyces	forms mycelium, aerobic, sporeforming, produces enzymes and antibiotics.	S. griseus

**Gram positive brewery bacteria with synonyms.**

Currently Accepted Names	Synonyms
Gluconobacter oxydans	Acetomonas oxydans
G. axydans subsp. Industrius	Acetobacter capsulatum [sic]
	Acetobacter viscosum [sic]
	Gluconobacter industrius
	Gluconobacter capsulatus
Acetobacter aceti	
A. aceti subsp. Xylinum	Acetobacter xylinoides
A. pasteurianus	A. vini-acetati
	A. agglutinans
	A. alcoholophilus
Citrobacter freundii	Escherichia freundii
C. intermedius	E. intermedia
	Paracolobactrum intermedium
Klebsiella pneumoniae	Klebsiella aerogenes
	Aerobacter aerogenes (non-motile forms)
Enterobacter cloacae	Aerobacter cloacae
E. aerogenes	A. aerogenes (motile forms)
Hafnia alvei	
Hafnia protea	Obesumbacterium proteus
	Flavobacterium proteus
Serratia spp.	
Erwinia herbicola	Enterobacter agglomerans
Zymomonas mobilis	Termobacterium mobile
	pseudomonas lindneri
	Saccharomonas lindneri
Z. anaerobia	Achromobacter anaerobium [sic]
	Saccharomonas anaerobia
Z. anaerobia var. immobilis	Saccharomonas anaerobia var. immobilis
Z. anaerobia var. pomaceae	Lactobacillus lindneri (Henneberg)
Lactobacillus brevis	L. plantarum
	L. pastorianus (Van Laer)
	L. pastorianus var. brownii
	L. brownii
	L. pastorianus var. diastaticus
	L. diastaticus
L. buchneri	L. parvus
	L. frigidus
Pedicococcus cerevisiae	Pediococcus damnosus (Mees)
	P. damnosus var. diastaticus
	P. mevalovorius

### Production of volatile acids by important wine yeasts.

Yeast Species	Volatile Acids in g/litre (as Acetic Acid)
Kloeckera apiculata (strain 1)	1.09-1.13
Kloeckera apiculata (strain 4)	1.01-1.04
Metschnikowia pulcherrima (strain 5)	0.13-0.14
Torulopsis stellata (strain 3)	1.08-1.28
Saccharomyces rosei (strain 6)	0.11-0.14
Saccharomyces uvarum (strain 8)	0.51-0.67
Saccharomyces uvarum (strain 10)	0.42-0.45
Saccharomyces cerevisiae (strain 2)	0.50-0.77
Saccharomyces cerevisiae (strain 9)	0.34

The preservation of vegetables by a lactic acid fermentation which act as antidotes. The lactic acid fermentation provides two complementary efforts. The restrictions in growth activities of undesirable micro-organisms through the generation of organic acids. The development of chemical and -products, provide the essential favour characteristics associated with a particular finished product.

### Difficulties in food processing and its solutions.

#### Processing of apple.

- Most of the bottle apple juice haze having the major component of Tannins and tannin -protein, hazes are the types most likely to present problems, during the first months after bottling. The haze protein action could be reduced by oxidation between depectinisation and pasteurisation.
- During processing of apple the degree of comminution in a harmermill is affected by screen size openings, hammer speed, type and alignment of hammers or blades, these factors affecting the efficiency of screw press for juice extraction in apple.
- The odour - active volatiles in apple cultivars must be removed during process.
- A characterisation of apple juice clarification with the use of honey. The honey helps in the clarification of pectinase enzyme and helps in juice processors.
- Carbonated apple juice, the carbonation is used as preservation and flavour enhancer in apple juice.
- Apple bruise detection using a micro-computers.

- **Apple pomace resource recovery.**  
Apple pomace is a by-product result during apple juice production. The application of anaerobic digestion followed by biodrying would enable maximum recovery of useful energy and the recovery of minimum solids produced in a dry marketable form.
- **Potato starch.**  
Sulphur dioxide used in potato starch manufacturing to inhibit the action of oxidative enzymes that would discolour the starch and starch drying procedures help in controlling the micro-organisms level.
- **Starch, sugar and syrups.**  
Corn starch, during steeping, process, lactic acid bacteria attack and gluten become softening. This bacterial attack can be controlled by lowering, pH at 3.9 to 4.1 suitable for discouraging harmful bacterial growth.
- **Mushrooms.**  
The processed mushrooms must contain whiteness and shelf life fresh and microbial growth on mushrooms can be controlled by washed and unwashed and use of steeped solution.
- **Meat and poultry processing.**  
Temperature affection initial level on bacteria on shelf life of beef. At 15°C (59°F) the Coli-Aerogenese and Microccoci spoil beef maximum. Rapid measurements are used for monitoring meat and poultry process. While measurements for evaluating, whether equipment and the processing environment are hygienically acceptable, also be considered. Poultry, red meats, are low-acid foods and must be processed in a pressure canner to make sure they are safe. Use the processing time and pressure specified for each type of product.
- **Processing of dairy products.**  
The control of micro-organisms in dairy products is a great challenge. The contamination organisms include lactic streptococci coliform, psychrotropic and thermoduric bacteria these organisms grow on milk and could reduce its keeping quality. New development in milk and cheese fermentation processes; the dairy industry exists in milk fermentaitons leading to yoghurt, butter milk, whey, soft, and ripened cheeses.
- **Melons, olives, apple and apricot processing.**  
Honeydew melons processed by frozen, olives processed by canned and passion fruit process by juice. Apple and apricot and cherries can be processed canned, frozen, dried, juices, glazed, spiced and made sauce, jelly, vinegar and confectionery.
- **Pickling vegetables.**  
Pickling vegetables: is the oldest method of food preservation. Preservation of pickling are two types: Brind (fermented) pickles require several weeks of "curing" at room temperautre. During this period colours and flavours change. Acid is produced as lactic acid bacteria grow.
- Quick (unfermented) pickles are made in 1 or 2 days by adding acid in the form of vinegar. Vinegar prevent bacterial growth.
- **Reclaiming used cherry brines.**  
Brines used for bleaching, curing and preserving sweet cherries can be made reusable by treatment with activated carbon. Before any brines are reconditioned for re-use they should be tested for the presence of polygalacturonase enzymes. These enzymes could result in softening of cherries. The present polygalacturonase enzymes should be activated by heat.

- **Spices.**

Raw spices are grown, harvested and prepared for distribution. During these process spices get attack of salmonella, shigella, E. coli, clostridium perfringens, and Bacillus cereus. The reduction of micro-organisms attack could be done by the use of ethylene oxide and large scale sterilisation.

- **Confectionary products.**

During preservative action the bactericidal effect on essential oils and certain alcohol are important. The coated cream and soft-centred chocolates are attacked by alcoholic, butyric or lactic fermentation. Alcoholic fermentation could be caused by normal or osmophilic yeasts, butyric fermentation by certain species of clostridium. Bacillus, Leuconostoc and Lactobacillus species might be caused in lactic fermentation yeasts and molds could cause spoilage in product such as marzipans, fondants and glaze fruits. the confectionery products suffer salmonella contamination, which could be controlled by the use of egg white, which is negative for Salmonella.

- **Sea food.**

E. coli and fecal streptococci, Micrococi from a small part of the bacterial flora of fresh fish. Staphylococcus aureus is rarely found in freshly caught fish, handling can cause contamination. The changes that occur with frozen fish and during any intermediate processing consideration. These contamination can be controlled by operational safety procedures.

- **Food and energy from cellulosic waste.**

The cellulose production world-wide is around 100 billion tones per year. 90% of the cellulosic waste is derived from agricultural sources. Urban industrial sources are only 10% of the total waste. Cattle feedlot. Fibre waste constitutes 50% of the waste. Manufacturing of food from cellulosic waste e.g single cell protein could be utilised as cattle feed (waste dung) and municipal refuse and utilisation of baggase.

## **Research work on fibre and food processing.**

The Research is required in the field of processing as under:

- Psychrotropic bacterial spores together with heat stable proteases and lipases produced by non-thermoduric psychrotrophs indicate the primary spoilage problem in the refrigeration of raw milk and diary products.
- Aflatoxin and Aspergillus flavus is removed from cow's feed, in order to control contamination.
- The use of pectins in making fruit jellies, increasing application as thickeners, emulsifiers.
- In honey gets zygosaccharomyces or torula type of yeast fermentation. This could be controlled at heating 190°F and packaging at this temperature.
- Canning fruits; selecting and preparing equipment, preparing fruits, maintaining colour and flavour, packing the jars, sweetening fruit, canning without sugar, processing in a water bath canner, cooling jar, seal.
- Procedures for sanitation in Retail Frozen Desserts like control of bacterial growth, organisms that cause communicable diseases in the product.

- The various factors which help prevent the presence of *L. monocytogenes* in cooked meat and poultry products.
- Influence of pre-processing handling on finished quality of sauces.
- Heat-stable protease cause flavour deterioration in cottage cheese.
- Salt is used as preservative, its concentration about 18-25% solution generally will prevent all growth of micro-organisms in food.
- Development of fermentation technology; is used for food preservation.
- The concentration of sugar in water is used to prevent microbial growth it depends upon the type of micro-organisms and presence of other food constituents, usually 70% sucrose in solution will stop growth of all micro-organisms in food.

**Certain vegetable contain toxic substances and these are still used for after processing modification and detoxification techniques.**

These are as under:

- Beans, fava-protease inhibitor, also vicine and convicine (Favism-inherited G-6-p dehydrogenase deficiency in man).
- Beans, lima-cyanogenic glucoside (HCN).
- Beans, soy-protease inhibitor; saponins, hemagglutinin.
- Beets-oxalates.
- Carrot - carotoxin.
- Crucifers (cabbage, cauliflower, thioglucoside).
- Cucumber - curcubitacin - bitter tasting glucoside.
- Lettuce - lactucopicrin - bitter taste.
- Potato, sweet - ipomearnarone (alkaloid).
- Potato, white - solanine, a bitter alkaloid.
- Spinach - oxalates.

### **Growth regulators.**

- Recently more crops for processing are treated with growth regulator e.g Alar can maintain or enhance the hardness, increase colouration.

The problem of non-uniformly bleached as well as incompletely bleached brined cherries is solvable by secondary bleaching with sodium chloride. The loss of texture, and development of off flavour.

- **Various methods used for studying the micro-biological activities in the processed food are as under:**

- \* Automated procedures used for micro-biological evaluation of food.
- \* The ISO-GRIDTM Hydrophobic Grid Membrane Filter (HGMF) methodology used in food microbiology.
- \* Use of a Bioluminescence ATP Assay in winery quality control.
- \* Use of bactometer Microbial - Monitoring System.
- \* Use of Spiral Planting System to determine bacterial concentration in various substances.
- \* Evaluation of diagnostic Kits - API, Entertube, Micro-ID, Minitek, AMS. These kits are used specifically for identification of Enterbacteriaceae, salmonella, shigella, yersinia and Escherichia used in food micro-biological identification.
- \* Use of an Enzyme Immunoassay and rapid biochemical identification system for detection of salmonella in low moisture foods.
- \* Rapid detection of salmonella in food using DNA probes.
- \* Control of turbidity in apple juice products by the use of pectin, which help in stabilising the turbidity.
- \* Concentration of liquid foods in a pilot scale falling film evaporator is important unit operation in food processing. Large quantities of fruit and vegetable juice, sugar and syrups are concentrated in several types of commercial evaporators.

- **Commonly used methods for pesticides residue determination are:**

- \* Chemical derivatisation or organochlorine residue identity.
- \* Enzymatic techniques for analysis.
- \* Flame detector for residue analysis by gas liquid chromatography.
- \* Gas chromatographic measurement and identification of pesticide residue with electron capture, microcoulometric and electric conductivity detectors.
- \* Infrared micro techniques used at microorganisms level.
- \* Ultraviolet spectrophotometry in analysis spectra - structure correlations.

- \* Paper and thin-layer chromatography.
- \* Combined gas chromatography - mass spectrometry for identification.
- \* Immunological techniques for analysis.

### **Irradiation.**

- Food irradiation is used, as a preservation method but it also brings changes in the food material. These irradiations are:
  - Invisible long radio and infrared heat.
  - Visible, red, orange, yellow, green, blue and violet.
  - Invisible short, ultraviolet total range.
  - Xrays, alpha, beeta and gamma rays.
  - Cosmic rays.
- The refrigerated and frozen food processing need refrigerated lorries for transportation and storage purposes.
- Freezing is the easiest method of food preservation. The main challenge during preservation is to control colour, flavour, nutritive value, freshness of the produce. Although selected method of preparation, packaging and the condition of freezing also affect on food processing.
- Heat preservation and processing.

The Toxin that can be formed by clostridium - botulinum is destroyed by 10 minutes exposure to moist heat at 100°C (212°F). Heat preservation means blanching, pasteurising and proper canning.

- Food dehydration and concentration method used.

Employment opportunities in fibre and food processing industries are as under:

- Farm inputs and machinery.
- Ag/forest/fishing service.
- Dairy farm products.
- Poultry and eggs.
- Cattle.
- Other livestock.
- Cotton.
- Other crops.
- Tobacco.

- Oil bearing crops.
- Horticulture/nursery.
- Forest products.
- Processed meat/eggs.
- Dairy processing.
- Misc. food processing.
- Gram/flour milling.
- Fats and acids processing.
- Soft drinks and liquor.
- Fabric mills and leather.
- Wood and paper processing.
- Food wholesale and retail.
- Food service.

### **Conclusion.**

The fibre and food processing industry is a very vast subject, it is based on combination of joint efforts of large fields of sciences like: microbiology, biochemistry, agriculture, post-harvest technologies, engineering and molecular biology etc.

The fibre and food industry is the backbone of agriculture. If we put more cottage industries this will open the door of employment in the rural areas and boost the economy of the country.

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