LECTURE 10

CEREALS AND CEREAL PRODUCTS

CHAPTER 17

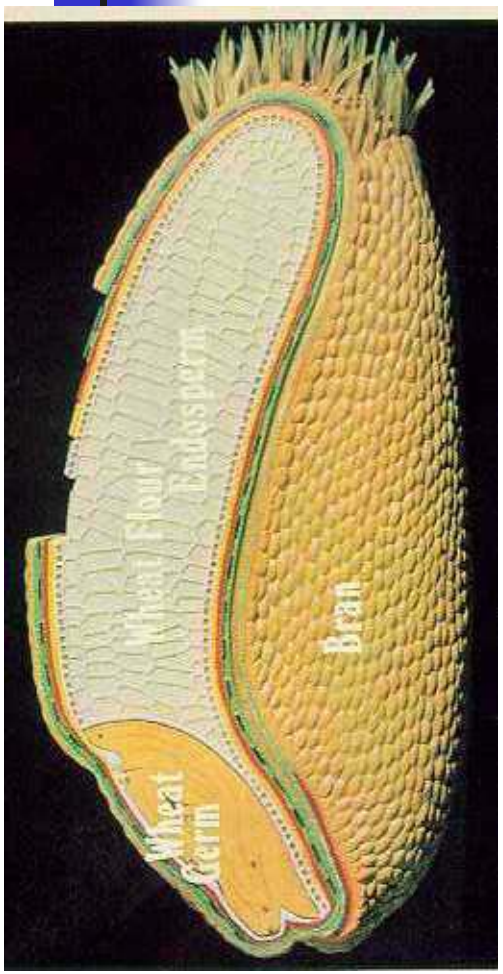
CEREALS

- Cereals are plants which yield grains such as wheat, rye, rice or corn.
- Cereal grains provide the world with a majority of its food calories and about half of its protein.
- These grains are consumed directly or in modified form as major items of diet (flour, starch, oil, bran, sugar syrups, numerous additional ingredients that are used during manufacturing of other foods), and they are fed to livestock and thereby converted into meat, milk and eggs.

Typical percentage composition of cereal grains

Grain	Moisture	CHO	Protein	Fat	Fiber	Kilocal / 100g
Corn	11	72	10	4	2	352
Wheat	11	69	13	2	3	340
Oats-yulaf	13	58	10	5	10	317
Barley-arpa	14	63	12	2	6	320
Rye - çavdar	11	71	12	2	2	321
Rice	11	65	8	2	9	310

CEREAL GRAINS

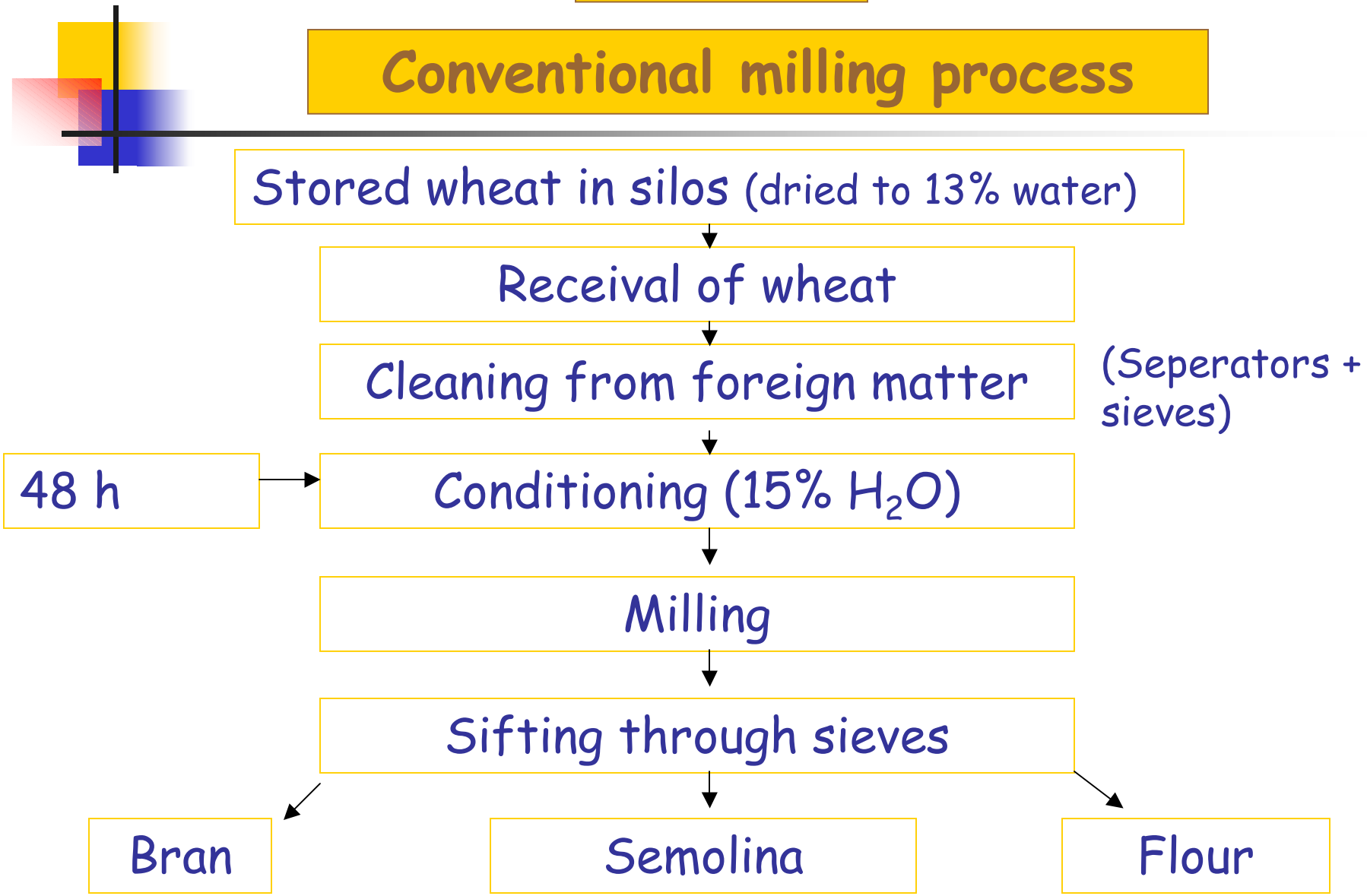


All of the cereal grains are plant seeds and they contain:

- A large centrally located starchy endosperm – rich in protein (83% of kernel)
- Protective outer layers, hull and bran (15% of kernel) – fiber, cellulose, vitamin B and minerals
- An embryo or germ located near the bottom of the seed (2% of kernel).

WHEAT

Conventional milling process



WHEAT

Extraction rate – The percentage of original weight of wheat entering the mill that is recovered as flour.

Rate 60-70 Extra-extra

70-80 Extra

80-90 First class (creamy)

>90 Second class (brownish)

>95 Whole-meal flour

Lower extraction rate – all the bran is removed. Flour becomes more stable.

Compositions of flours of different extraction rates per 100g

Extr. rate	Cal/ 100g	Protein g	Fat g	Vit B_1 mg	Riboflavin, mg	Niacin, mg	Ca mg	Phytic acid* mg
100	328	13,6	2,5	0,37	0,12	3,5	28	242
85	339	13,6	1,7	0,29	0,07	2,1	19	96
70	341	12,8	1,2	0,08	0,05	1,2	13	30

* Anti-nutritional factor, binds Ca + Fe

BREAD MAKING PROCESS

Dough:

Flour 100 kg

Water 65 kg

Baker's yeast (*Saccharomyces cerevisea*) 2 kg

Salt 2 kg

Sugar 4 kg

→ Dough-mixing

↓

Mechanical kneading

Water+flour ... Flour enzymes convert starch to maltose then to glucose. Glucose is used by the yeast to produce etil alcohol and CO_2. Mechanical action of blades stretches the gluten fibers.

↓

BREAD MAKING PROCESS

Bulk fermentation

$C_6H_{12}O_6 \longrightarrow 2\ C_2H_5OH + 2\ CO_2\uparrow$

25-35 °C, 2-4 hours, dough volume increases as CO_2 is produced.

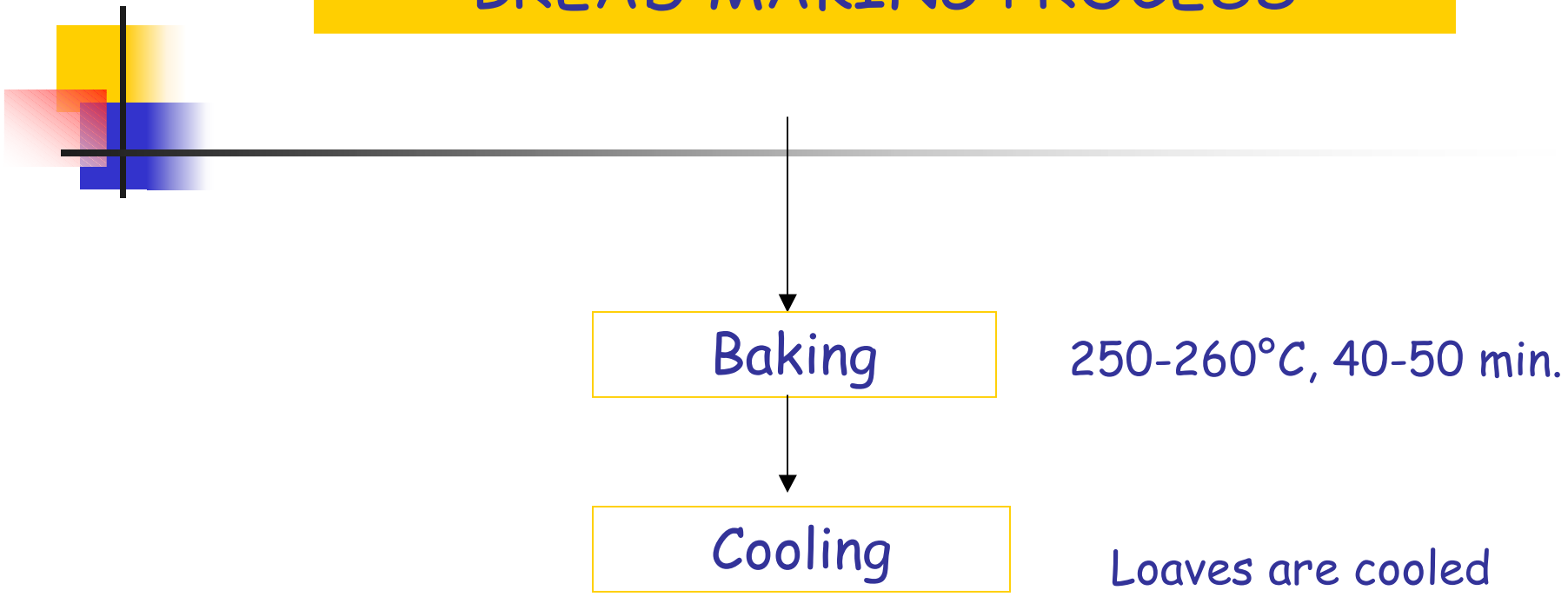
Dough dividing and moulding

Cutting into pieces and rolling into balls.

Proving in T °C controlled compartments

35-38 °C

BREAD MAKING PROCESS



Major baking ingredients and their functions:

Gluten:When moistened and mechanically worked, it forms an elastic dough.

Wheat starch does not form elastic films as does gluten; rather the moistened starch, when heated, forms a paste which stiffens and gelatinizes.

These two constituents of flour together are capable of forming a batter or dough depending on the amount of water employed.

Major baking ingredients and their functions:

Yeasts:

Two forms of yeast are used in baking-" moist" pressed cakes and "dehydrated" granules. Both forms consist of billions of living cells of *Saccharomyces cerevisea.*

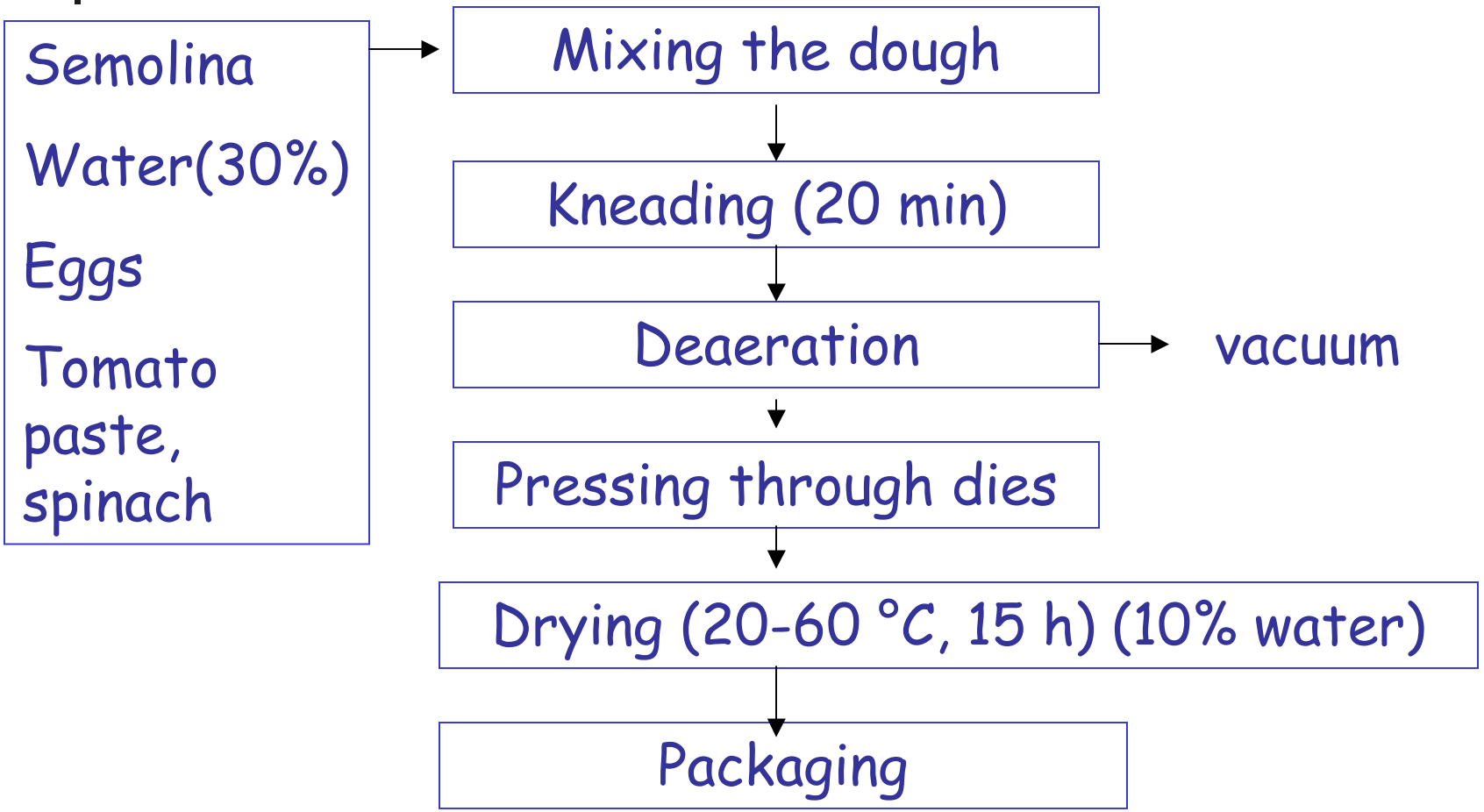
When rehydrated the yeast begins metabolism and fermentation. Yeast ferments simple sugars and from sugar it produces carbon dioxide and alcohol. Alcohol is lost at baking temperatures and CO_2 expands the dough volume as it tries to escape from the gluten film.

Major baking ingredients and their functions:

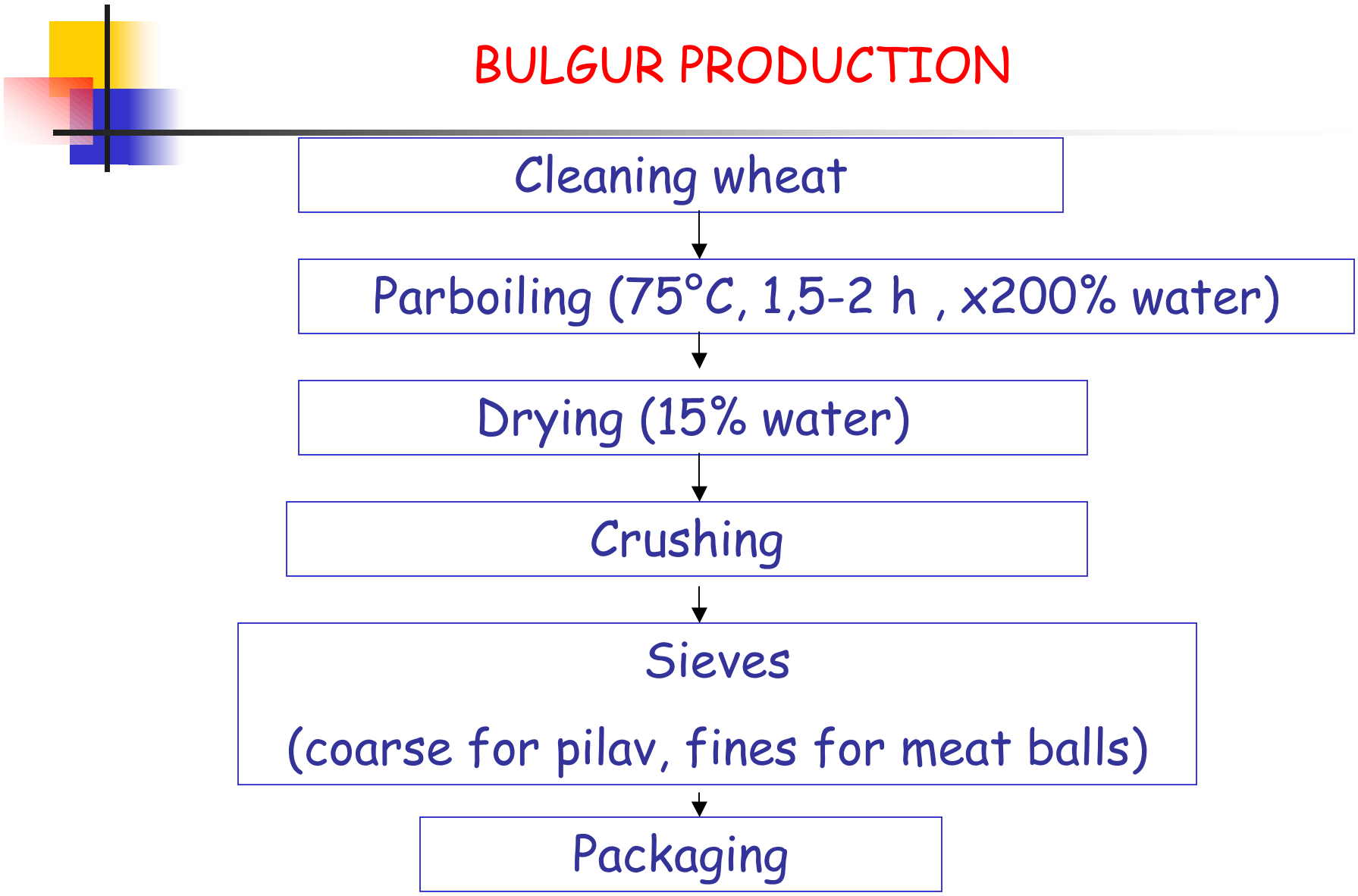
LEAVENED FOODS

- "Leavening": Entrapping gas in a system, thus expanding dough volume
- Yeast-raised goods: Breads and sweet doughs leavened by carbon dioxide from yeast fermentation
- Chemically leavened goods: Cakes, doughnuts and biscuits raised by carbon dioxide from baking powers and chemical agents.($NaHCO_3$, mono calcium phosphate)
- Air-leavened goods: Angel cakes and sponge cakes made without baking powder.
- Partially leavened goods: Pie crusts, crackers where no intentional leavening agents are used yet a slight leavening occurs from expanding steam and other gases during the baking process.

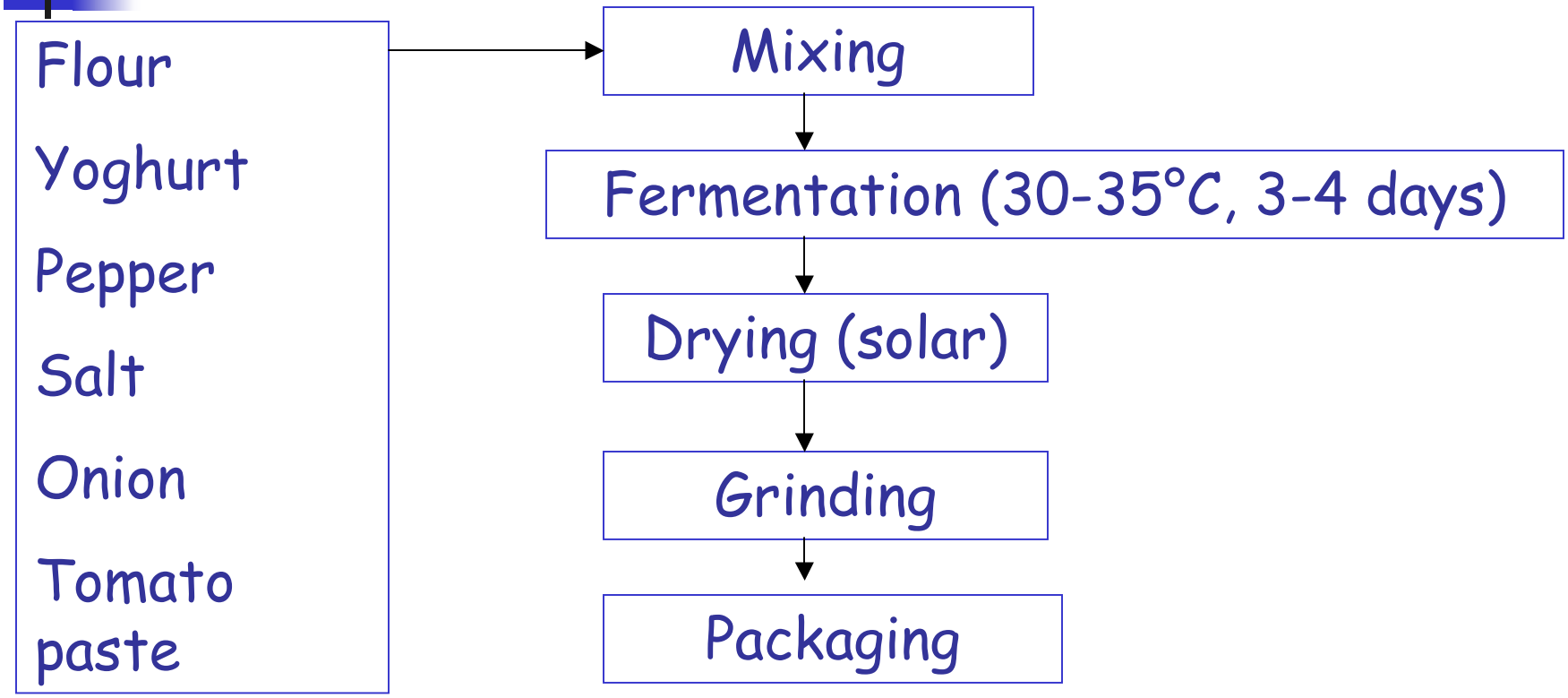
MACARONI PRODUCTION



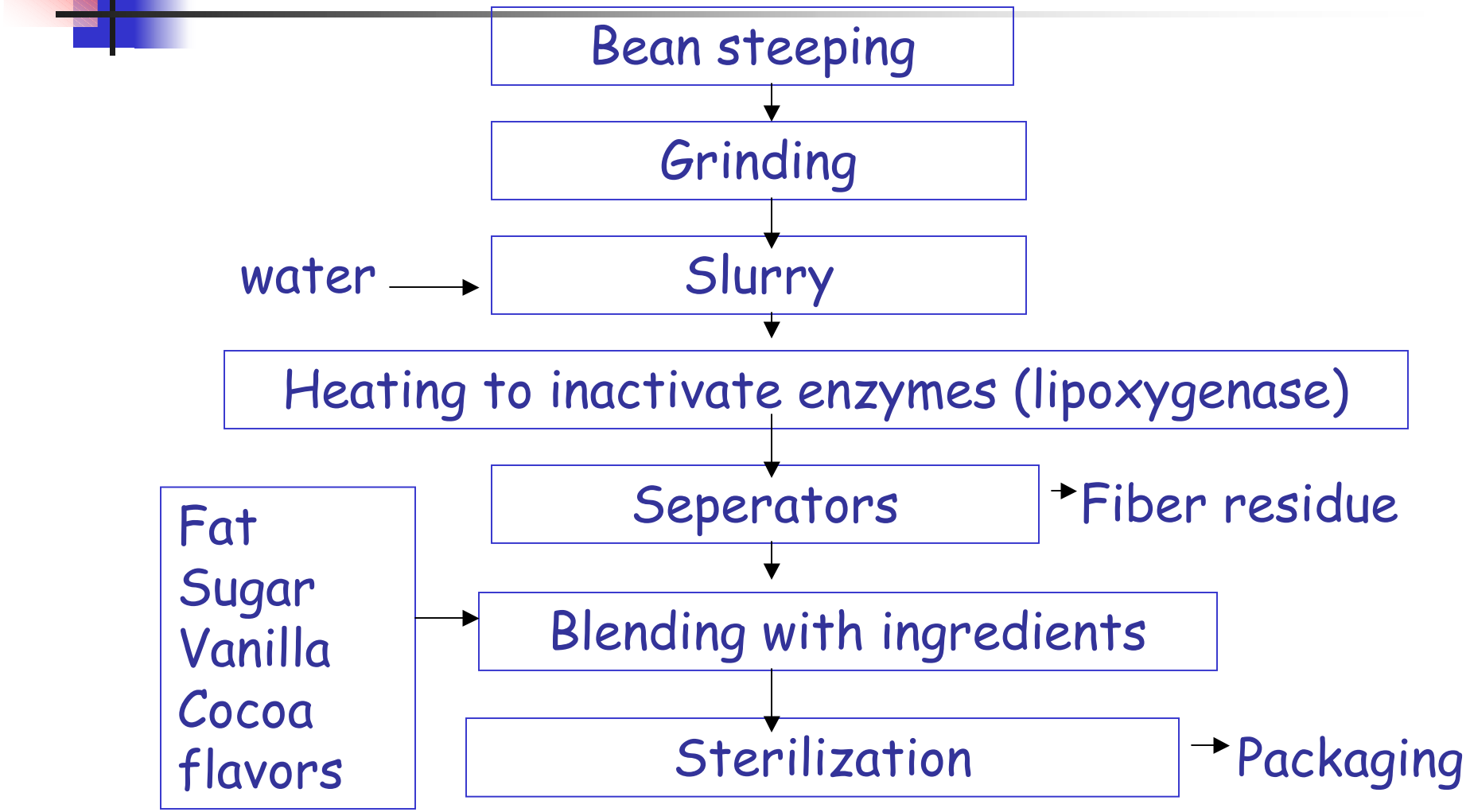
BULGUR PRODUCTION



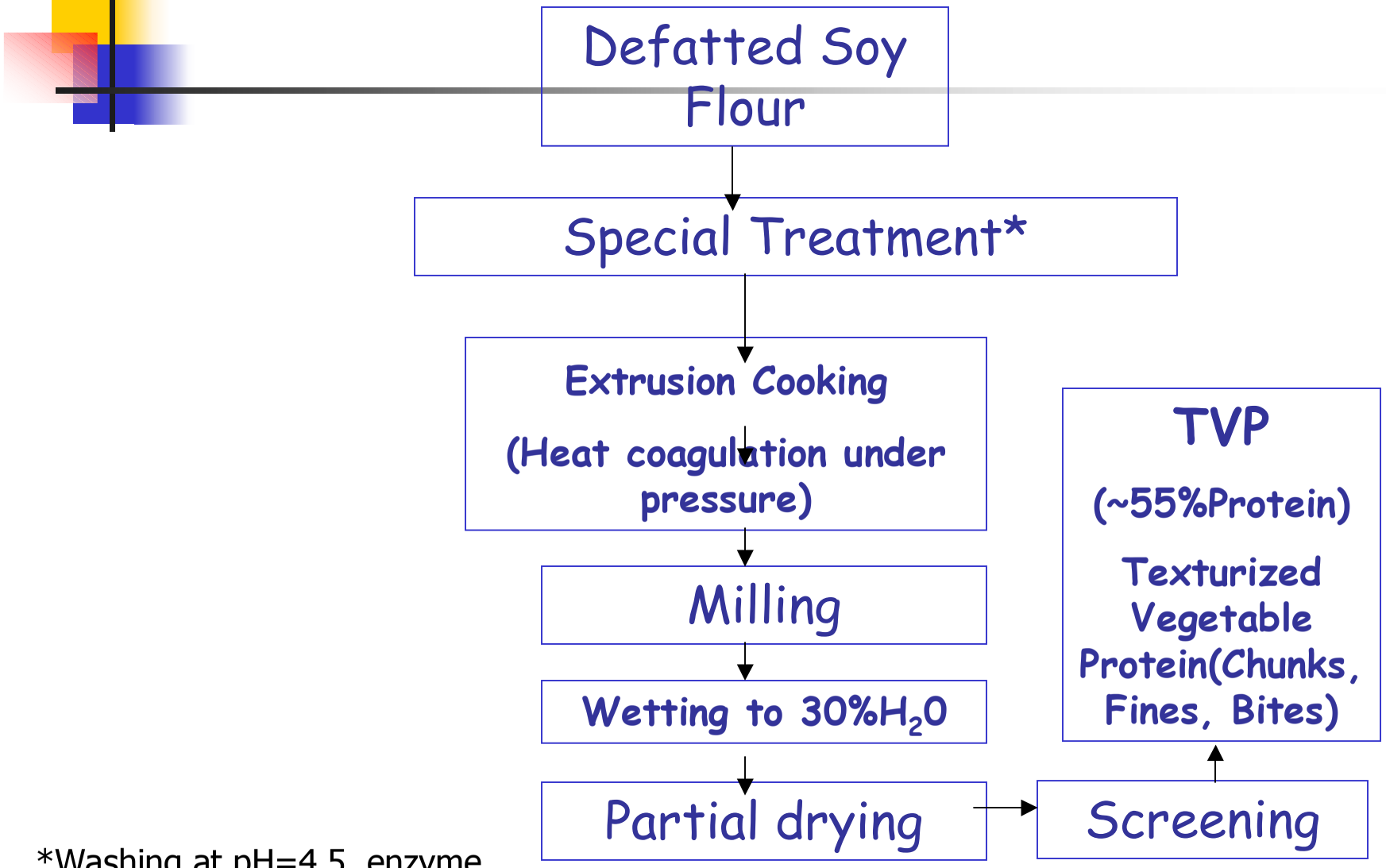
TARHANA PRODUCTION



SOY MILK


Bean steeping
Grinding
water
Slurry
Heating to inactivate enzymes (lipoxygenase)
Seperators
Fiber residue
Fat
Sugar
Vanilla
Cocoa
flavors
Blending with ingredients
Sterilization
Packaging

MEAT ANALOGUES (Fig.17.13-15)



*Washing at pH=4.5, enzyme modification, disolving in alkali

INTRODUCTION TO FOOD SCIENCE AND TECHNOLOGY

FRUITS-VEGETABLES AND THEIR PRODUCTS

COMPOSITION

- The composition of vegetables and fruits depends not only on botanical variety, cultivation practices and weather but also on the degree of maturity prior to harvest and the condition of ripeness, which continues after harvest and is influenced by storage conditions.
- Most fresh vegetables and fruits are high in water, low in protein, and low in fat. The water content is generally greater than 70% and frequently greater than 85%. Protein content is no greater than 3,5% and fat content no greater than 0,5%.

	Examples
Earth vegetables	
Roots	Sweet potatoes, carrot
Tubers	Potatoes
Bulbs	Onion
Herbage vegetables	
Leaves	Cabbage, spinach, lettuce
Petioles (leaf stalk)	Celery
Flower buds	Cauliflower, artichokes
Sprouts	Asparagus
Fruit vegetables	
Legumes	Peas, green beans
Cereal	Sweet corn
Vine fruits	Squash, cucumber
Berry fruits	Tomato, egg plant
Tree fruits	Avocado

Typical percentage composition of edible portion of foods of plant origin.

Food	CHO	Protein	Fat	Ash	Water
Potatoes	18,9	2,0	0,1	1,0	78
Carrots	9,1	1,1	0,2	1,0	88,6
Radishes	4,2	1,1	0,1	0,9	93,7
Asparagus	4,1	2,1	0,2	0,7	92,9
Green bean	7,6	2,4	0,2	0,7	89,1
Peas	17,0	6,7	0,4	0,9	75,0
Lettuce	2,8	1,3	0,2	0,9	94,8
Banana	24,0	1,3	0,4	0,8	73,5
Orange	11,3	0,9	0,2	0,5	87,1
Apple	15,0	0,3	0,4	0,3	84,0
Strawberry	8,3	0,8	0,5	0,5	89,9
Melon	6,0	0,6	0,2	0,4	92,8

QUALITY OF FRUITS AND VEGETABLES

Affected by:

1) Pre-harvest condition
   Botanical variety of fruits and vegetables
   Method of cultivation- irrigation frequency, soil composition, climatic conditions
   Climate and weather conditions at plantation and growth
2) Harvest condition
   Degree of maturity at harvest (unripe, mature-optimum for harvesting, ripe-optimum for eating, early senescence, senescence-unedible form)
   Mechanical or hand harvesting condition

QUALITY OF FRUITS AND VEGETABLES

3) Post-harvest condition

Transport conditions

Storage conditions

Processing conditions

QUALITY LOSS

1) Physical changes – Loss of turgor "equilibrium moisture level within cells depends on osmotic forces, the semi-permeable membrane allows for passage of water" (transpiration)

   When plant tissues are damaged or killed by storage, freezing, cooking or other causes, denaturation of the proteins of the cell membranes occur, resulting in the loss of perm-selectivity. Water and dissolved substances are free to diffuse out of the cells and leave the remaining tissue in a soft and wilted condition.

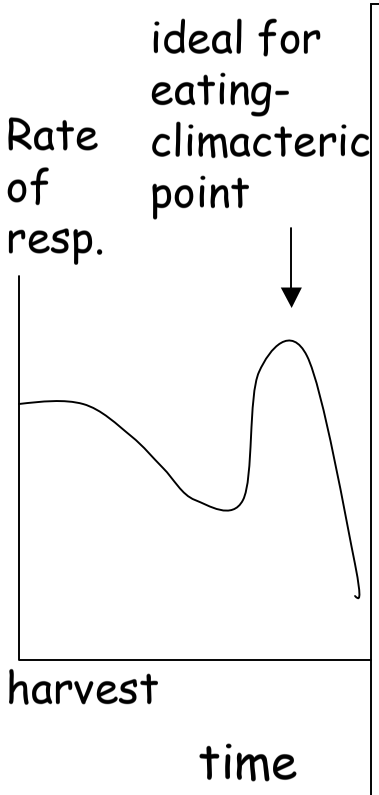
QUALITY LOSS

2) Chemical Changes:
   Vitamin C oxidation
   Change from starch to sugars
3) Enzymatic changes:
   Enzymatic browning due to polyphenol oxidase
   Tissue softening due to pectinase enzymes.
4) Microbiological changes:
   Yeasts and molds

Antimicrobial agents can be used, Controlled Atmosphere storage,

Oranges can easily be infected with *Penicillium digitatum.*

FRUITS



Climacteric fruits

Continue ripening after harvesting.

Apricots

Peaches

Banana

Tomatoes

Plums

Non-climacteric fruits

Do not ripen after harvesting.

Grapes

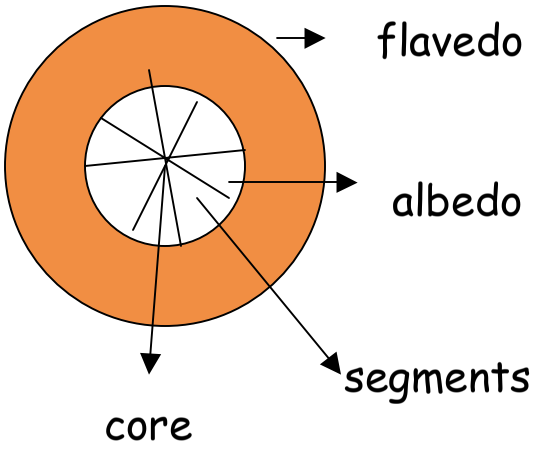
Cherries

Oranges

Strawberries

(No climacteric point)

ORANGE JUICE PRODUCTION



Mechanical Washing → Soil+dirt

Selection and sorting → Spoilt fruits

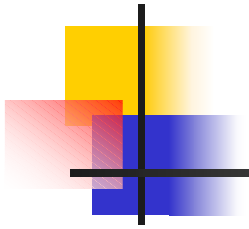
Juice extraction → Solid wastes

Filtering

Deaerator → Single strength juice 12-13% dry matter

Concentration by evaporating (65% dry matter)

Yield of juice: 40-50%



Pasteurization

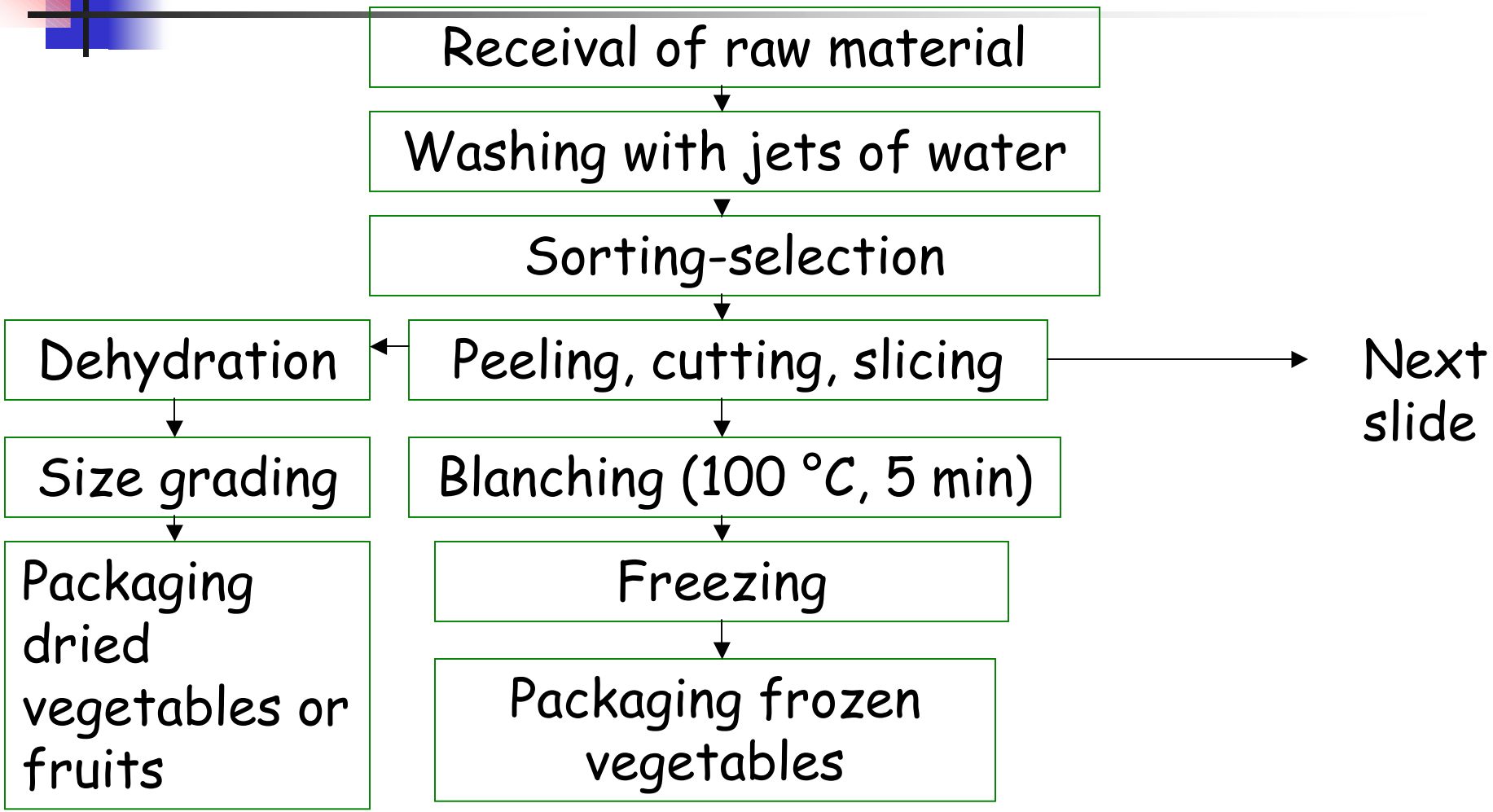
Heat treatment:

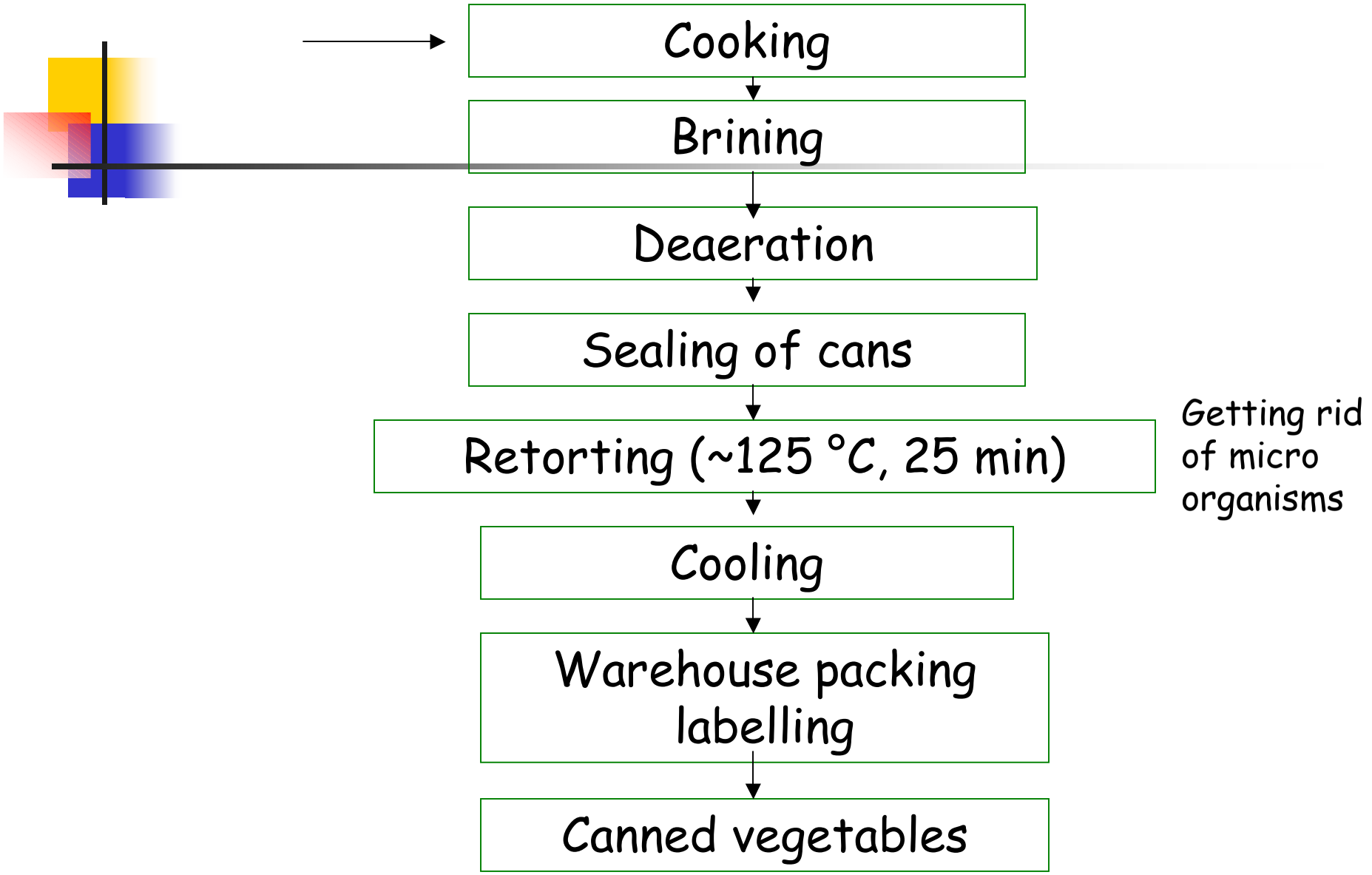
1) **65°C 30 min**
2) **135 °C few sec. (HTST)**

Packaging

Aseptic packaging
Bottles, cans, paper-packs

POST-HARVEST PRACTICES FOR VEGETABLES




Cooking
Brining
Deaeration
Sealing of cans
Retorting (~125 °C, 25 min)
Getting rid of micro organisms
Cooling
Warehouse packing labelling
Canned vegetables

INTRODUCTION TO FOOD SCIENCE AND TECHNOLOGY

BEVERAGES AND CONFECTIONERY PRODUCTS

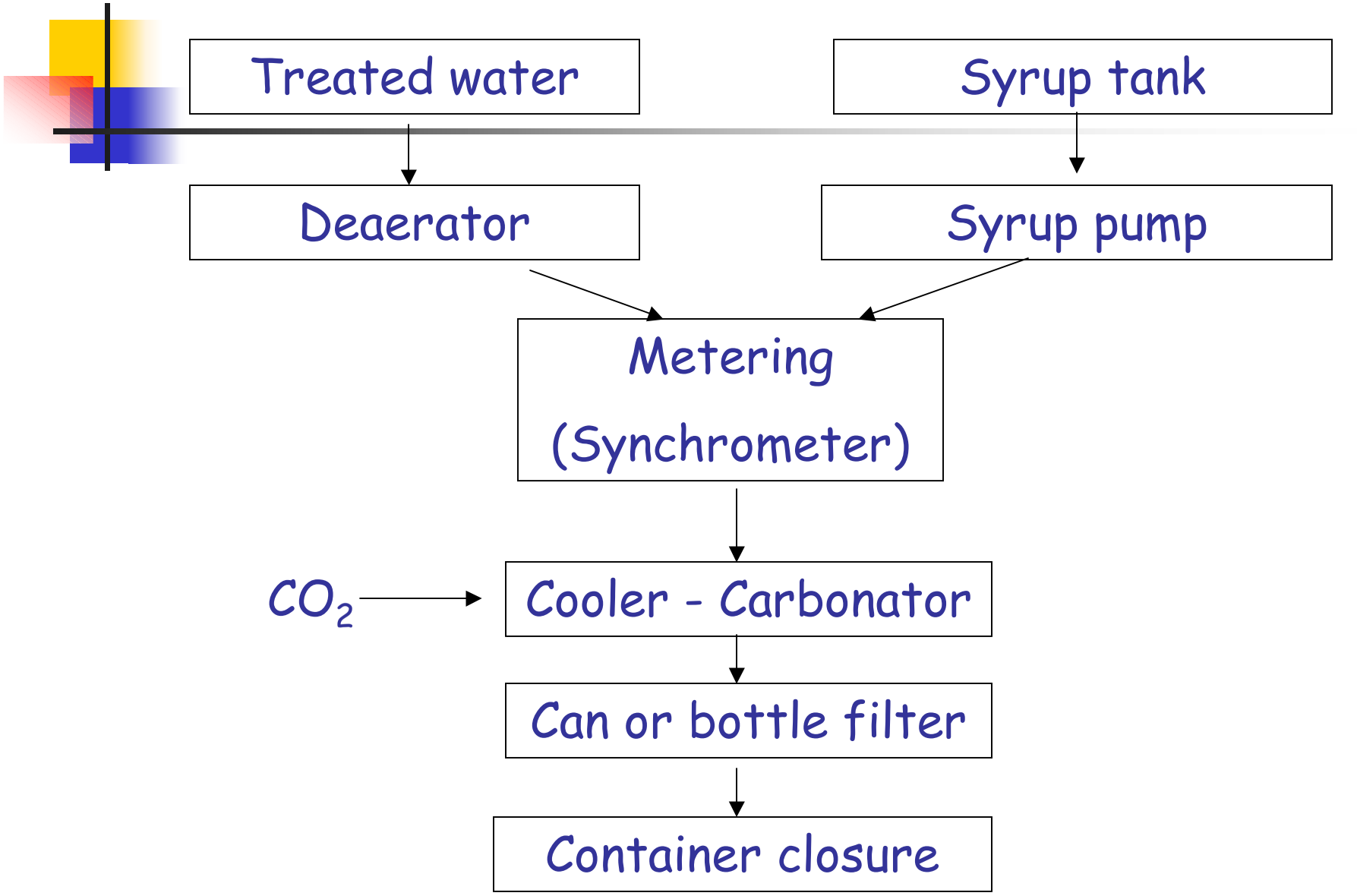
CHAPTER 19

CHAPTER 20

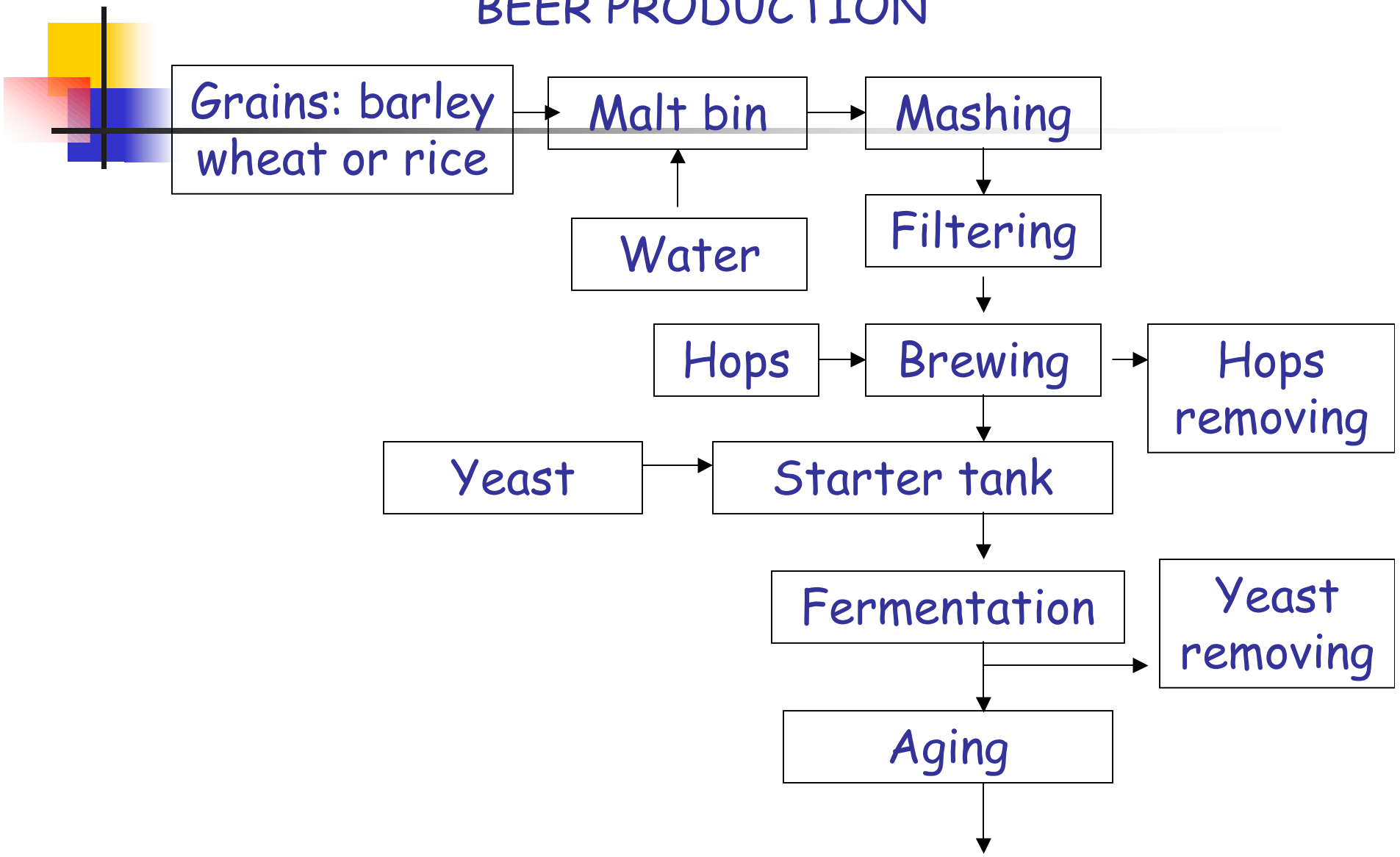
BEVERAGES

- ✓Some beverages are consumed for their food value (e.g. milk) yet others are consumed for their thirst-quenching properties, for their stimulating effects, or simply because consumption is pleasurable.
- ✓Carbonated nonalcoholic beverages or soft drinks "soda pop"
- ✓Carbonated or noncarbonated mildly alcoholic beverages –beer, wine
- ✓Nonalcoholic, non-carbonated stimulating beverages- coffee, tea.

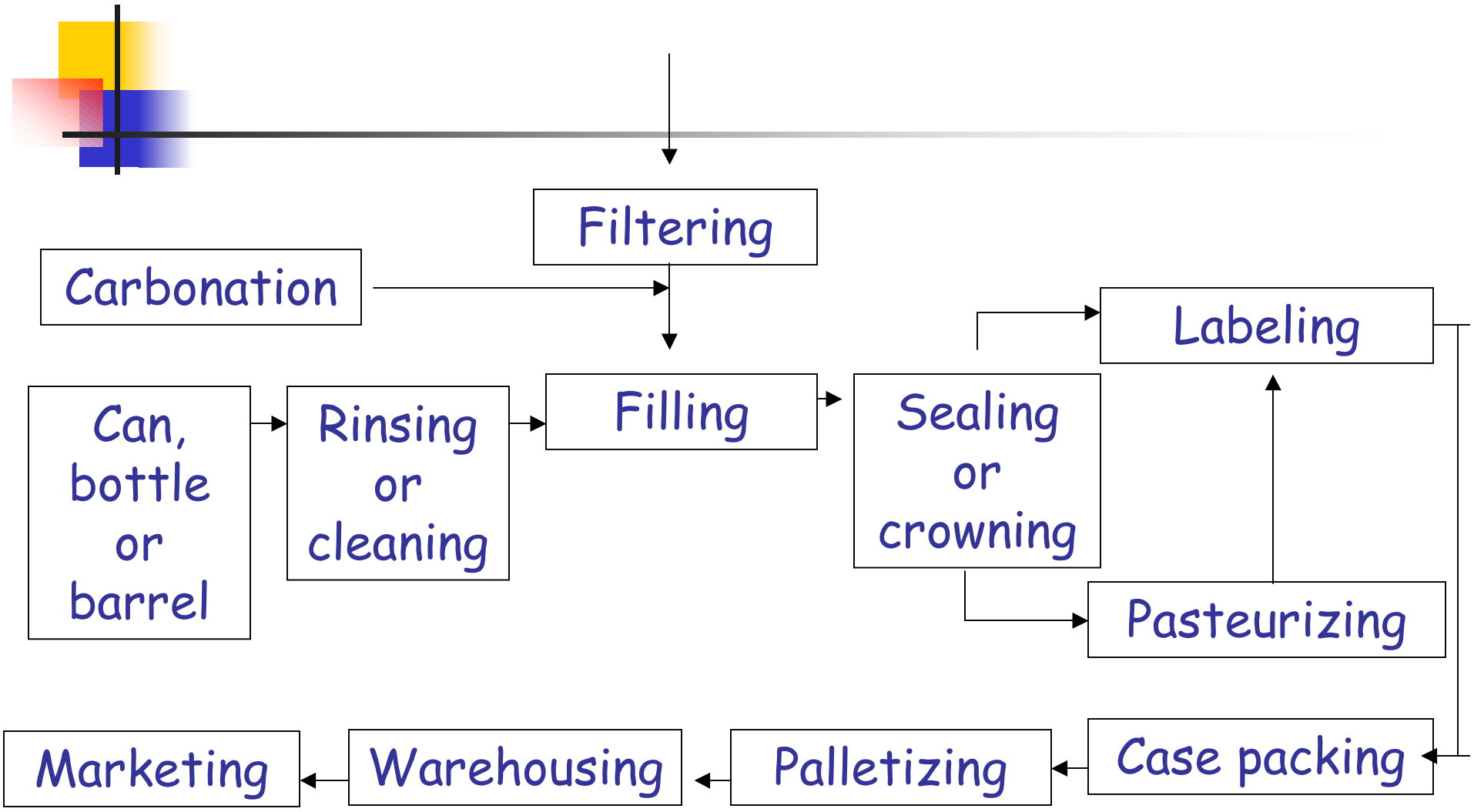
Soft drink manufacture



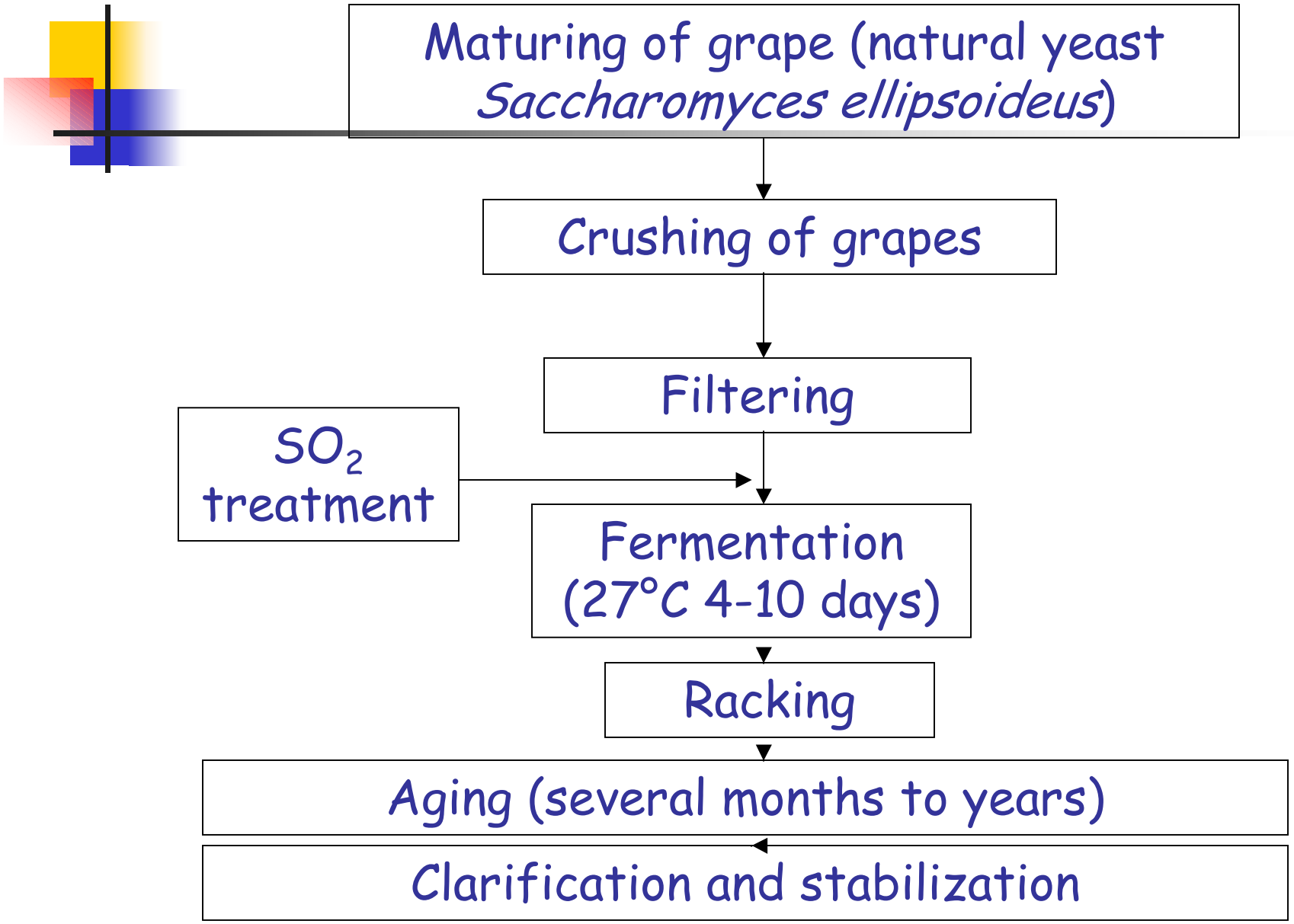
BEER PRODUCTION



BEER PRODUCTION

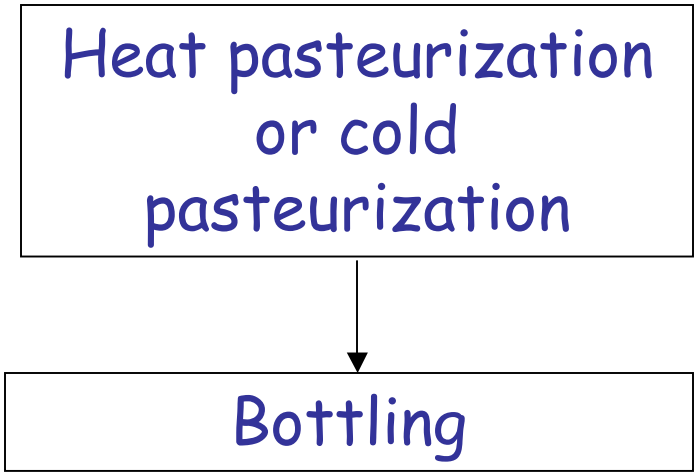


WINE PRODUCTION



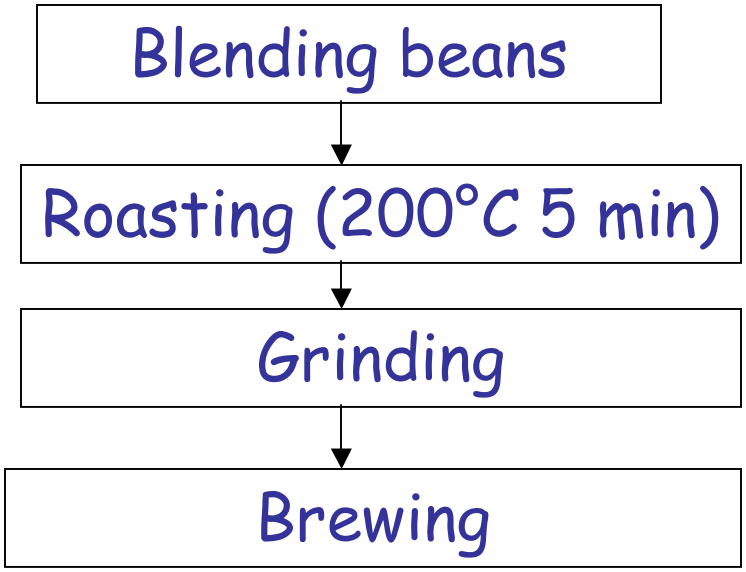
WINE PRODUCTION

If a wine is not above 17% alcohol;



COFFEE

Both tea and coffee contain virtually no food value in themselves and are consumed entirely for their refreshing and stimulating effect.



Black Tea

Withering the plucked leaves to soften them and partially dry them.

↓

Passing the withered leaves under rollers to rupture cell walls and to release the enzymes and juices

↓

Fermenting the rolled leaves by exposing them to air about 27°C 2-5 h.

↓

Drying the fermented leaves in ovens at about 93°C. 4% moisture, inactivates the enzymes.

CONFECTIONERY AND CHOCOLATE PRODUCTS

- Confections can be divided into two broad categories:
- Those inwhich sugar is the principal ingredient and those which are based on chocolate.
- Sugar type confections include: nougats, fondants, caramels, taffees and jellies.
- Chocolate based confections: chocolate-covered confections, chocolate-panned confections, chocolate bars, chocolate-covered fruits, nuts and cremes.
- Many other ingredients including milk products, egg white, food acids, gums, starches, fats, emulsifiers, flavors, nuts, fruits, are used in candy-making.

Ingredients

- Sucrose: Sugar from sugar cane or beet.
- Invert sugar: Is related to sucrose and common in confections. Sucrose canbe hydrolyzed by acids or enzymes into two monosaccharides glucose and fructose. The hydrolyzed mixture of fructose (levulose) and glucose (dextrose) is called invert sugar.Can prevent or help control the degree of sucrose crystallization.
- Corn syrups: Are viscous liquids containing dextrose, maltose, higher sugars and dextrins. They are produced by the hydrolysis of corn starch using acid or acid-enzyme treatment.

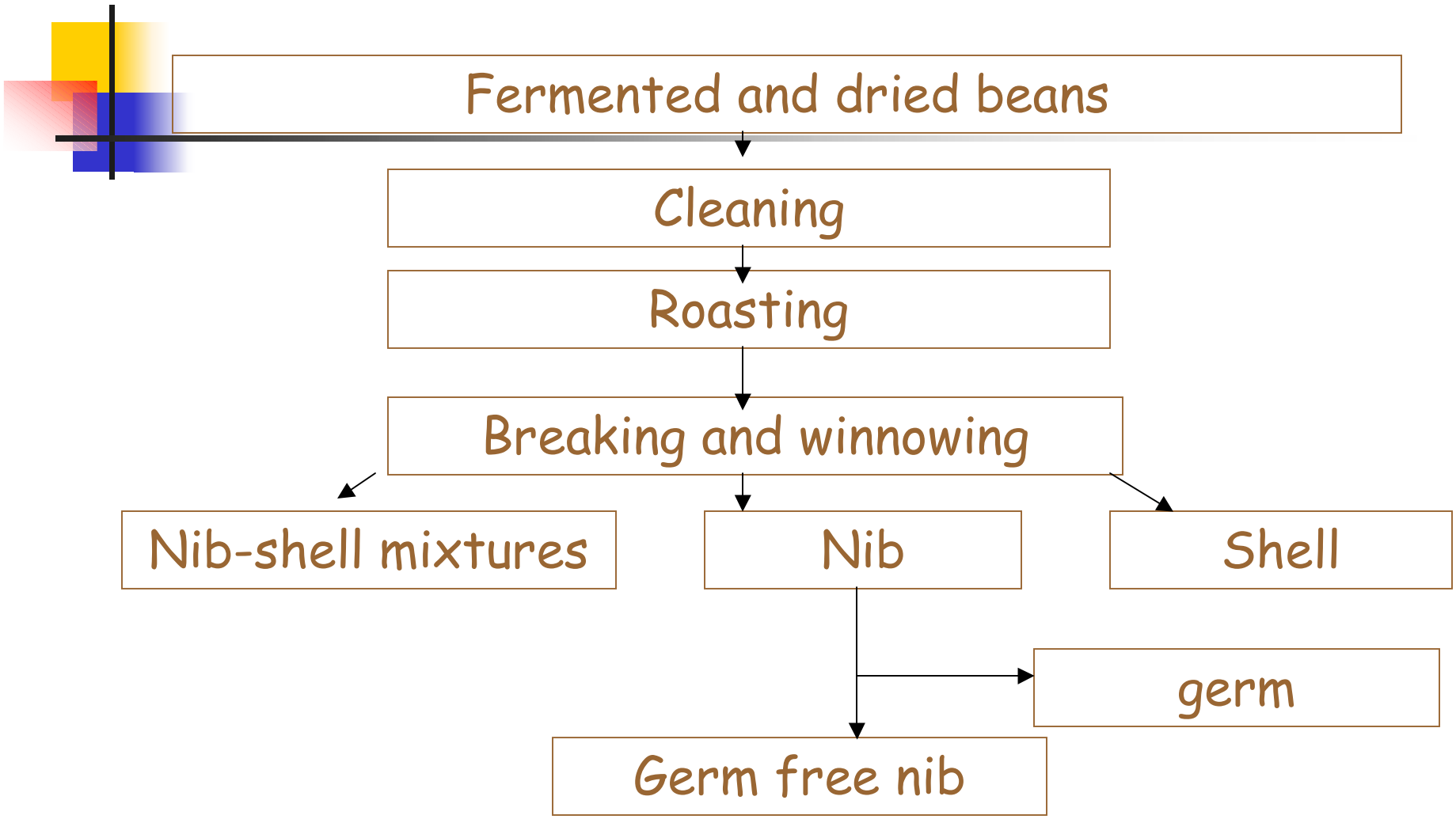
Ingredients

Sugar substitutes: The abilityof sucrose to cause denatl cavities and its caloric content have led to the use of sugar substitutes in some confections.

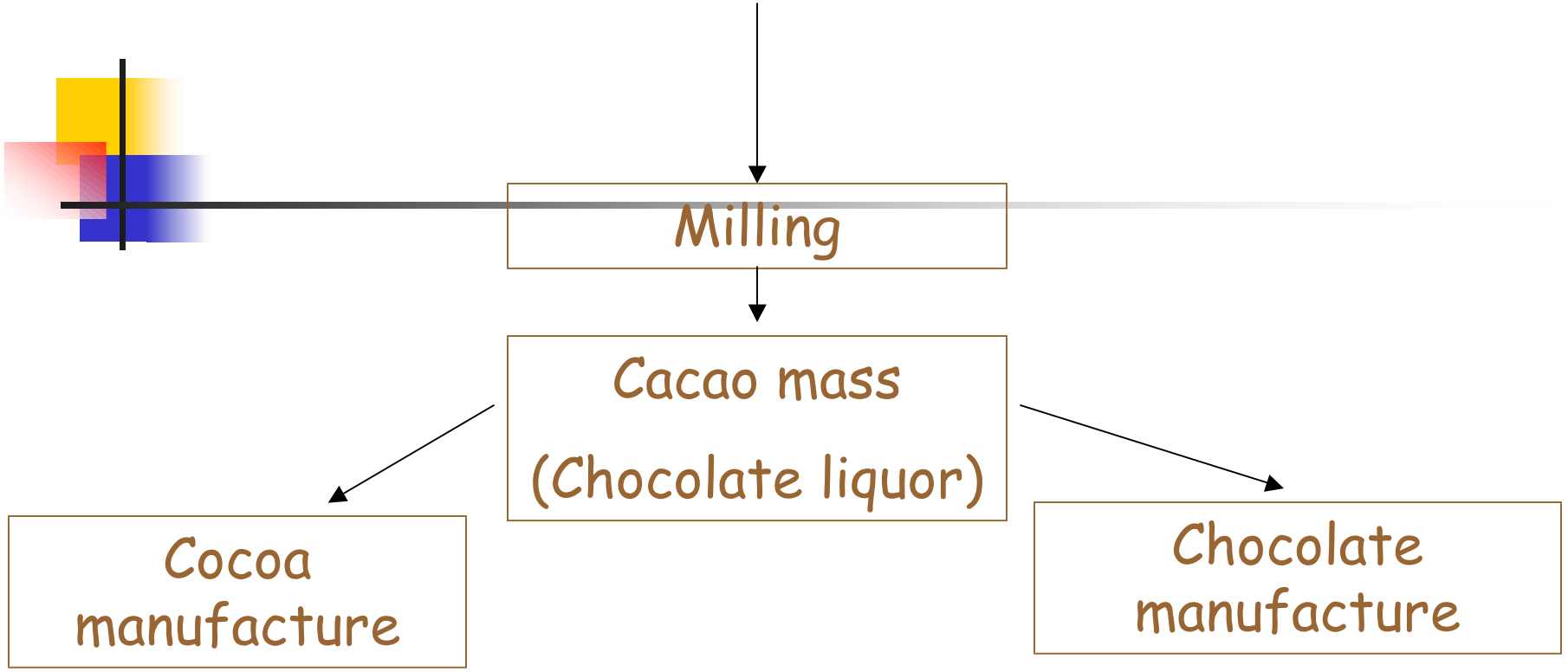
Bulk sweeteners (alcohol derivatives of sugars are not fermentable by bacteria in the mouth, do not contribute to cavities, but do have caloric values as sucrose, e.x. Sorbitol, xylitol, mannitol)

High-intensity sweeteners (caloric and non-caloric) – saccharin, sucralose, thaumatin, aspartame, Acesulfam K, do not have bulking or mouthfeel of sugar.

CHOCOLATE MANUFACTURING



CHOCOLATE MANUFACTURING



CHOCOLATE MANUFACTURING