UNIT 10: RAISING AGENTS

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1.0 Introduction

In some food processes especially in baking, raising agents are used. This is to improve the textural integrity and the consistency of the food. Such agents must be harmless and must not introduce undesirable taste, colour or odour to the food.

This unit therefore, treats the common raising agents used in food preparation and the production of some of these raising agents

2.0 Objectives

At the end of this unit, you should be able to:

- List the types of gases used as raising agents
- Describe both the chemical and the biological production of Carbondioxide
- Describe the production of yeast

3.0 Main Content

3.1 Types of Gases Used as Raising Agents

The types of gases used as raising agents are:

a. Air, introduced mechanically.
b. Water vapour, that is produced by heat on water
c. Carbondioxide that could be produced either chemically or biologically

The most important of these gases used as raising agents is carbondioxide and some of the chemical compound used in the generating of these gases are sodium bicarbonated, monocalcium phosphate, acid sodium, aluminium phosphate and guconodelta lactones. These are some of the permitted agents that are used in the food processing.

Air is mechanically introduced into the food by whisking, beating, sifting and folding. Foods that have foaming properties will be suitable for this method of aeration. This method is used in cake making

Water vapour is also used for the aeration of wet mixture of food that can be subjected to strong heating.

Carbondioxide is used as raising agent when it is deliberately introduced to mixtures especially for mixing bread rolls. This method is not commonly applied.

However, carbondioxide is produced within the mixture by either chemical action or biological actions.

3.2 Chemical Production of Carbondioxide

3.2.1 Reaction Between Acid and Carbonate

All carbonates react with acid to produce salt, water and carbondioxide. In foods some amount of sodium bicarbonate may be made to react with acidic ingredients such as sour milk, vinegar and fruit juice to produce carbondioxide. However, the amount of carbondioxide produced may not be much. To produce greater amount of carbondioxide the bi-carbonate may be reacted with acidic powder such as "cream of tartar" or in the alternative baking powder may be employed.

3.2.2 Baking Powder

There are three major ingredients in baking powder: sodium bi-carbonate, an acid compound and filler.

The filler, usually starch either corn or rice is used to separate carbonate and the acidic compound so as to prevent their premature reaction. The acidic compound, depending on the brand of the baking powder may be tartaric acid, acid potassium-salt of tartaric acid, acid calciumphosphate, acid sodium pyro-phosphate and compound which can hydrolyse to acids such as sodium aluminium phosphate and lactoses.

When water is added to the baking powder, the reaction between the acid component and the sodium bi-carbonate in the production of carbondioxide commences either in cold water or hot water depending on the type of acid components.

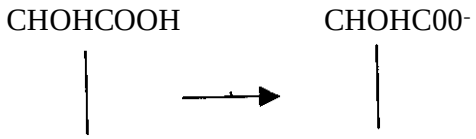
On the basis of these, we have tow types of baking powder, "quick action" baking powder and, "delayed action" baking powder. In quick action baking powder, the acid salts dissolves in cold water and the reaction with carbonate commences. In delayed action baking powder the dissolution of the acid in water and the commencement of carbondioxide are possible during the heating process.

However, there is greater demand for double action baking powder that allows carbondioxide to be produced in both cold and hot water. Baking powder made from tartaric acid and cream of tartar known as acid potassium salt of tartaric acid are "quick action" baking powder. Whereas, those manufactured fro acid calcium phosphate, sodium aluminium phosphate and lactoses are double action baking powders. It should be remembered that these acids and acids salts ionize and some hydrolysed to hydrogen ions, Fr.

This hydrogen ions combines with bi-carbonate ion (HC63) to form water and carbondioxide, H+ F110 + CO,

Carbondioxide

Tartaric acid in cold water ionizes to tartaric ion and two hydrogen ions (CHOHCOOH), $(CHOHC00)^2$ + 21·-r cream of tartar or acid potassium salt of tartaric acid ionizes to tartrate ion, one hydrogen ion and one potassium ion as follows



I molecule potassium hydrogen tirate | 1 tartrate ion | Ihydroge I potassium ion | ion

Acid Calcium Phosphate (ACP) also hydrolyses to gydrogen ions.

$2CaH_4(PO_4)_2 \rightarrow Ca_3(PO_4)_2 + 4HPO_4^{2-} + 8H$

3 molecules of ACP | 8 hydrogen ions

Acid sodium pyro-phosphate, (ASP) ionizes well at baking temperatures to hydrogen ions as follows:

$Na_2H_2P_2O_7 \rightarrow 2Na^{1-} + P_2O_7^{4-} + 2H^+$

It should be noted that cream of tartar is an expensive ingredient to use because of the production of only one hydrogen ion from the molecule of the compound. Acid calcium phosphate also serves as a flour improver and acid sodium py-o-phosphate is capable of impaction bitter flavours if it is used exclusively as the acid component in the baking powder.

The hydrogen ion produced from these entire reactions combine with bicarbonate ion to produce carbondioxide and water. .

3.2.3 Thermal Decomposition of Carbonate

When carbonates especially sodium bicarbonate and ammonium bicarbonate that are permitted in food processing are heated, there will be production of carbondioxide.

$2NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$

sodium bicarbonate | sodium carbonate

$NH_4HCO_3 \xrightarrow{\text{heat}} NH_3 \pm H_2O + CO_2$

This method is used in cake making and the use of ammonium bicarbonate is only limited to commercial production of biscuits. The sodium carbonate

residue when heated with sugar gives a strong yellow to brown colours to cake. This alkaline residue also decreases the amount of thiamin in baked foods. For this reason a ot of consideration is being given in favour of biological production of carbondioxide as a raising agent.

3.3 Biological Production of Carbondioxide

The flour contains starch subtrate on which yeast can act during fermentation that is anaerobic respiration. Even when supply of oxygen is during aerobic respiration, carbondioxide can be evolved from the reaction of starch subtrate and oxygen.

In anaerobic respiration that is fermentation glucose as a result of glcolysis is converted to pyruvic acid.

$$C_6H_{12}O_6 \xrightarrow{4\ 1\ 1} 2CH_3COCOOH$$

Pyruvic acid through the process of decarboxylation gives acetydehyde.

$$CH_3COCOOH \xrightarrow{CO,} CH_3CHO$$

Acetyldehyde on reduction gives

$$CH_3CHO \xrightarrow{+/El} C_2HSO_{1-1}$$

From all these reactions we can see that glucose is fermented to give ethanol and carbondioxide and this fermentation is done by yeast. For bread and beer making the yeast, saccharomyces, cerevisiae is used. For fermentation, we have

$$C_6H_{1-1}O_6 \xrightarrow{\text{Fermentation}} C_2H_SO_{11} + 2CO_2$$

In aerobic respiration, the glucose reacts with oxygen to produce carbondioxide, water and energy.

$$C_6H_{12}O_6 + 60, \longrightarrow 6CO_2 + 6H_2O + \text{Energy}$$

The aerobic respiration results into greater energy yield than anaerobic respiration. In all these reactions monosaccharides have been used. In some reactions the yeast can make use of disaccharides such as maltose and of sucrose which are first converted respectively by maltose and sucrose to monosaccharides. It is the monosaccharide that is used for either fermentation or aerobic respiration.

Student Assessment Exercise 10.1

10.1.1 What are raising agents?
10.1.2 How is carbondioxide produced biologically'?

3.4 Consideration for the Yeast and Baking Powder

a Hints on using baking powder

- I. The baking powder must be measure accurately .
- ii. It must be mixed properly with the flour
- iii. Do not slam the oven door in the early stages of cooking
- iv. Insufficient and excess baking powder must be avoided to prevent heavy texture (insufficient) and the collapse of the structure (excess).

b Hints on the use of yeast.

i The yeast must be removed from the refrigerator and used at room temperature

it The liquid for mixing the dough must be at 36°C - 37°C.

iii. We should remember that salt retains the activity of yeast and temperature of over 52°C destroys yeast

iv. The flour bowl and liquid used for mixing should be warm.

v. The yeast dough should be well kneaded to make the dough elastic and to allow the even distribution of yeast

vi. Over-proving and under-proving should be avoided

3.5 Foods that Require the Use of Raising Agent

We use baking powder in sponge puddings, cakes and scones and in suct puddings and dumplings.

We use yeast for the following foods:

Bread dough: rolls, white, brown, whole meal loaves e.t.c

Buns dough: doughnuts, swiss, currant

Croissants, frying batter, Danish pastry.

4.0 Conclusion

The unit treats raising agents and how they are introduced to the food. The unit further extensively treats both chemical and biological productions of carbondioxide that is used as raising agent in bread making and cake.

The raising agent must be harmless and must not impact undesirable colour, taste and odour to the food.

5.0 Summary

The unit gives importance of the raising agent in the textural integrity of food. It also states that air, mechanically introduced, water vapour, produced by heat on water and carbondioxide produced chemically and biologically are gases used for aerating the food substance.

Carbondioxide is considered most commonly used and its production is extensively treated. Reaction of acids with carbonate produces carbondioxide. The use of baking powder in which sodium bicarbonate is made to react with hydrogen ions produced from tartaric acid, cream of tartar and calcium phosphate and acid sodium pyro-phosphate produces carbondioxide.

Carbondioxide is also produced from the thermal decomposition of sodium bicarbonate and aluminium bicarbonate. The biological production of carbondioxide comes from fermentation in which monosaccharides especially glucose is fermented by yeast especially saccharomyces cerevisiea to produce ethanol and carbondioxide.

Aerobic respiration also produces carbondioxide, water and energy.

6.0 Tutor Marked Assignment

Discuss the chemical production of carbondioxide for use as raising agent in food.

10.1.1 See answer in Section 3.1 of this unit
10.1.2 See answer in Section 3.3 of this unit

7.0 References and Other Sources

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