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SENSORY EVALUATION OF FLAVOL

by

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B. S., Pahlavi University, Shiraz, Iran, 1969

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

in

FOOD SCIENCE

Department of Grain Science and Industry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1973

Approved by:

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INTRODUCTION AND REVIEW OF LITERATURE

Bread has been fundamental for man's survival since ancient times. The history of bread goes back nearly 8000 years and is the story of civilization itself.

Currently, cereals make up about 50-80% of the total food intake in most underdeveloped countries. The role of bread and the necessity for intensive bread production has increased with the upward surge of world population. Development of automation and continuous processing methods have been the means of supplying the increasing demands of large markets for bread. Although, these developments allow closer control of the operation, better sanitation, and a more uniform product, mechanized bread production has caused some difficulties as related to desired aroma and flavor in the baked product.

Research has demonstrated that production of bread flavor precursors (amino and organic acids) occurs during fermentation. The most recent advances concern the addition of flavor precursors in a known ratio to dough and complete elimination of primary fermentation. The objective of this investigation was to evaluate consumer preference for bread made with addition of flavor precursors as a supplement and complete elimination of fermentation.

Flavor Definition and Sensory Evaluation Methods

Flavor is a concept which is difficult to objectively define. It has been defined as "a mingled, unitary experience which includes sensations of taste, smell and pressure, and often other cutaneous sensations such as warmth, cold, or mild pain. Flavor also is an attribute of foods, beverages and seasonings resulting from the stimulation of those senses which are grouped together at the entrance to the alimentary and respiratory tracts--especially odor and taste" (7).

Caul (4) stated that the term taste refers to those sensations perceived through the stimulation of the receptor cells enclosed within the taste buds, located principally on the tongue. Generally, it is agreed that there are four distinct kinds of tastes: sweet, salty, sour, and bitter. Typical examples of stimuli: for sweet is sucrose; for salty is sodium chloride; for sour is citric acid; for bitter is quinine. The taste-producing chemical must be soluble in water or saliva to reach the enclosed receptor cells and then initiate the electrical response which travels along the nerve fiber ultimately to the brain for decoding. Caul (5) also demonstrated that taste has not only qualitative aspects but also quantitative aspects. The strength or intensity of a taste will vary with the concentration of taste stimulating chemical, proceeding from "not detectable" to "just detectable" (detection threshold) to "just recognizable" (recognition threshold), and on in increasing strength to a maximum where increments in concentration no longer produce further taste responses.

Odor is a sensation due to stimulation of the olfactory receptors in the nasal cavity by gaseous material. The chemical stimuli of odor are volatile molecules, traveling in inspired air. During normal breathing it has been estimated that only 5-10% of the inspired air passes into the olfactory slit. Unlike tastes, which are only four in number, odors are not readily categorized. Man can probably discriminate the odors of 10,000 or even more chemicals (5). In the flavor literature, the term aroma refers to all chemicals perceived in the nose when external air is inspired. The individual sensations, odors and feelings comprise the aromatics of the product. Most of these aromatics will also be perceived by the nose during the act of eating.

Caul (4) stated that literature concerning the relation of feeling sensations to flavor is extremely meager. However there is no doubt in the minds of food product developers that sensations arising from both physical and chemical properties of food are significant contributors to food acceptance and preference.

Flavor can be judged only by a living person. Sensory evaluation of foods involves concepts of physiology and psychology. Drake and Johansson (9) have demonstrated that physiology, especially the physiology of receptor organs, is an important basis of sensory evaluation. Physiological techniques have been used to study the behavior of various types of receptors, nerves and nerve centers. General physiology is often combined with anatomy and histology and has provided evidence of some interest for the field of sensory evaluation. Based on such studies, theories have been developed for various physiological functions such as olfaction.

Many external factors influence the sensitivity to various stimuli, such as the influence of sound or light on olfactory discrimination. In some cases, diseases or an unusual physiological status can contribute to a more or less abnormal function of the sense organs. A boundary between physiology and psychology is not always easy to define. A certain overlapping between the two disciplines is therefore unavoidable.

Drake and Johansson (9) also stated that sensory evaluation of food can be obviously considered as part of psychology. One aspect is that many properties have to be perceived and/or their intensities estimated. Another aspect is that humans are influenced in their judgment by many external and internal factors, which can be often of a psychological nature. Perception is one of the most fundamental concepts of flavor psychology and it can be rigorously defined only by referring to the function it performs within a complete theory of psychology. Because of the variety of existing psychological theories, however, there is no generally accepted definitions of perception. Generally, it may be said that perception refers to the hypothetical effect of stimulation, impinging on a subject (input). Such effects are not directly observable and can only be studied in terms of the behavior of the subject (output).

Unsophisticated forms of sensory analysis of food have been performed since ancient time. As a science, however, the discipline is relatively new. This is demonstrated by the fact that there are few textbooks written in this field. Sensory evaluation methods can be divided into two groups: absolute methods in which each sample is tested independently of other samples, and comparisons methods in which at least two samples are tested simultaneously. In the first case, various scoring and scaling procedures are often used. In the second case, three sub-cases can be distinguished: the existence of a difference, the direction of a difference, and the magnitude of a difference. In addition to the two mentioned groups of methods, the descriptive tests such as flavor profile and texture profile methods may be added (9).

Johnson and El-Dash (17) stated that flavor evaluation can be a powerful marketing tool. Flavor may influence new product development, product and process improvement, processing, storage, stability, and marketing. Therefore, flavor evaluation can make a significant difference in the success or failure of any given line of food products.

Organoleptic tests have been designed which seek to estimate the taster's impression upon eating samples of food. Organoleptic is defined as: "affecting or making an impression upon an organ or the whole organism; capable of receiving an impression; and sometimes as a synonym for 'sensory' when referring to examination by taste and smell" (7). There are a number of test methods for organoleptic flavor evaluation of bread. Some are in general use and are widely accepted. However, choice of flavor evaluation tests depends on the objective of evaluation, type of product and size of the organization which participates in flavor evaluation. Flavor evaluation may take the route of consumer preference tests which define expressions of degrees of liking or choice of a product relative to the others. Experience has shown that the flavor of bread varies with consumer preference and locality. Consumption of bread will undoubtedly increase if the combination of variables, which consumers in each locality prefer, can be found.

Thomas and Rothe (29) stated that the presence of a substance in concentrations above the threshold of human perception must be established before it may be assumed to be a component of bread flavor. Also, interaction between compounds may alter the threshold level. Cathcart (3) pointed out that factors other than ingredients influence bread flavor. These factors include: absorption, type of formula, mixing, make-up, punching, methods of fermentation, proof time, size of pans, baking conditions and freshness of baked product. Pelshenke (24) has shown that the principal factors influencing bread flavor are time, temperature, rate, duration, and nature of fermentation, baking temperature, baking time, type of flour and type of loaf.

Ingles _et al_. (15) found that the best procedure for bread flavor evaluation is to use sliced bread, wrapping two slices together in a 10" x 12" piece of water-proofed cellophane paper held together by a rubber band. According to Platt (3) three samples of bread are about the maximum number that could be judged with any degree of accuracy at one time by a judge. The judging of aroma and flavor in bread is not a simple procedure and great care is necessary in experimental design and preparation of samples (15). In other words, every possible effort must be made to make the different samples as uniform as possible, at the tasting stage, any factor which might cause a variation in the results must be eliminated, if possible. One may object that bread, in general, is eaten either with other dishes or is used for sandwiches or with butter, etc., and is seldom eaten dry. Cathcart (3) reported that the flavor of bread will manifest itself more clearly and distinctly if it is offered plain, and it is undoubtedly correct to assume that the samples of bread will keep this manifestation if it is used for sandwiches.

King _et al_. (20) stated that the use of a large number of judges does not increase the validity of the results of the test on bread flavor. A large untrained group of judges are no more accurate than a small group of trained judges. Ingles _et al_. (15) stated that six judges gave adequate coverage when bread samples are three. The Committee on Sensory Evaluation of the Institute of Food Technologists (7) recommends the use of 3-10 trained judges, 8-25 semi-trained judges or more than 80 untrained judges for rank-order type tests when the number of samples per test is 2-7.

Source of Bread Flavor

Fairly extensive research has been performed concerning the effects of fermentation and baking on various bread flavor stimuli. In 1939, Baker and Mize (1) found that normally fermented dough baked without crust formation, by using the dough as an electrical resistance between two electrodes, had inferior (mild) flavor and aroma. Likewise, bread baked with crust formation but without proper fermentation, also yielded inferior flavor. They concluded that both fermentation and baking are necessary for acceptable bread flavor.

Recent advances in analytical instrumentation, such as chromatography, ultraviolet, infrared and mass spectroscopy, coupled with classical organic analysis, have permitted much progress in the search for basic bread flavor stimuli. Nearly 70 compounds including organic acids, esters, alcohols, aldehydes and ketones which may affect the flavor of bread have been isolated from preferments, doughs, oven vapors on bread (6, 8). In addition, many other unidentified compounds have been isolated which may contribute appreciably to bread flavor (6, 30). The origins of most of these compounds are unknown. Many of the compounds isolated in dough and preferments are found in appreciable quantities in the oven vapors, indicating that they are volatilized during baking. The extent of the loss of these compounds has not been determined. These observations have led to the belief that thermal reactions during baking are perhaps the most important source of substances affecting flavor. Fermentation may be necessary as a source of flavor precursors, which react during baking to form bread flavor components.

Lüers (22) believed that knowledge of bread flavor could be obtained by studying alcoholic fermentation. The Emden-Meyerhoff-Parnas scheme indicates that ethanol, acetaldehyde, and carbon dioxide are major products of yeast fermentation. However, other compounds are formed in trace quantities (12). Yeast utilizes amino acids by oxidizing the amino acid to an imino acid which then reacts with water to yield an alpha-ketocarboxylic acid and ammonia. The alpha-ketocarboxylic acid is usually cleaved into an aldehyde with liberation of carbon dioxide (13). Alcohols and organic acids may be formed by reduction or oxidation of these aldehydes respectively.

Microorganisms other than yeast play an important role in the production of odorous compounds during fermentation. Johnson and Miller (18) considered that bacteria might be more important than yeast in the production of organic acids in dough fermentation. Linko et al. (21) studied the effect of several different microorganisms on the amounts of carbonyl compounds in preferments. They found that Pediococcus cerevisiae was the only microorganism which had a pronounced effect by substantially increasing the quantity of acetone. Bacteria produce acetic, lactic and higher acids, butyl and higher alcohols, and carbonyl compounds (13). Robinson et al. (26) grew several selected microorganisms in preferments and found that acceptable bread flavors were produced. Carlin (2), using bacteria-free yeast, found that the bread had considerably less flavor than normal yeast bread. This suggested that supplementation with the proper microorganisms might result in flavor improvement. Certain bacterial cultures particularly Leuconostoc and certain strains of lactic acid bacteria, were favorable to production of good bread flavor.

The chemical reactions that occur during oven baking give rise to both volatile and non-volatile compounds which contribute to the flavor of bread. The French chemist, Maillard, was the first to describe the reaction of amino acids and reducing sugars to form brown colored polymers called melanoidins (23). Ellis (11) defined Maillard's reaction as the reaction of the amino group of amino acids, peptides or proteins with the carbonyl function of sugars, which is followed by other more complex changes, eventually resulting in the formation of brown polymers. Ellis also stated that the reaction is affected by the temperature, moisture content, pH, reactivity, concentration of reactants and reaction time. Generally, the rate of Maillard's reaction decreases at low pH values, low temperatures and in high or low moisture-content systems.

Hodge (14) stated that the initial reaction in Maillard's browning is a condensation between a free amino group and the aldehyde group of reducing sugars to form a N-glycosylamine. The N-glycosylamine undergoes the Amadori rearrangement to form an N-substituted 1-amino-1-deoxy-2-ketose. Up to this point no browning occurs. The 1-amino-1-deoxy-2-ketose undergoes subsequent dehydration, fission, condensation and polymerization reactions which finally produce complex, highly colored melanoidins.

Kiely et al. (19) reacted twenty amino acids and eight different sugars in aqueous solutions at different pH values. The reactions were conducted at 50, 60 and 150°C. The aroma that was produced in each reaction was judged by the use of flavor profile techniques. They found that the sugar influenced the rate of reaction, but that the odor was controlled by the amino acid.

Rooney et al. (27) studied both the coloration and production of carbonyl compounds in model systems. Development of coloration and production of carbonyl compounds were attributed to the Maillard-type reaction. The rate of browning and carbonyl compound formation changed with various sugars. Xylose was most reactive, followed by glucose and maltose.

Bread Flavor Improvement

The first step in bread flavor research is to identify and attempt to understand the means by which processes or compounds may affect flavor. Johnson and El-Dash (17) grouped the possible ways of improving bread flavor into three categories. The first is condensing oven vapors evolving during bread baking and adding the condensate back to dough or bread. Wiseblatt and Kohn (32), in order to achieve significant enhancement, found it was necessary to add condensate volumes equal to 50 times those originally obtained from bread. Much of the aroma concentrate evaporates during baking and therefore does not affect bread aroma. The second category consists of addition of amino acids to the dough. Investigators using radioactive glycine (25) agreed with Kiely (19) that the source of amino group may be more important to aroma development than the carbohydrates.

Salem et al. (28) studied the effect of reactions between amino acids and glucose or xylose on the production of carbonyl compounds, color, and aroma in bread. They postulated that reaction of amino acids and sugars increased the color intensity of bread crust. Xylose produced a darker crust color than glucose. The crust color was influenced by the kind of amino acids when the amino acids were reacted with the same sugar. The amount of carbonyl compounds increased in bread crust when amino acids were added, while sugar had no effect. However, Johnson and El-Dash (17) stated that this second approach failed to provide a pleasing total bread aroma. This is likely due to the fact that the ratio of the amino acids required for acceptable bread aroma is critical.

The third approach to enhancing bread flavor is the use of proteolytic enzymes in bread making. This approach was undertaken by El-Dash and Johnson (10) on the premise that free amino groups could be provided in certain ratios to react with reducing sugars during baking through controlled proteolysis of wheat proteins during sponge fermentation. Addition of papain to the bread formula was made at 75, 150, 300, 700 and 1000 hemoglobin units (H.U.) per 700 gm. of flour. Papain was effective in producing water-soluble nitrogen in the dough after 340 minutes of fermentation. The soluble nitrogen was shown to represent free amino groups. Above 500 H.U., papain caused liquefaction of the dough. Since the rate of condensation of sugar with amino groups is dependent on concentration, it might be expected that the increase in free amino groups would increase the crust color of bread. As more free amino groups became available, the extent of the browning reaction increased, creating more carbonyl compounds which in turn led to more intense crust browning and bread aroma.

Flavol,* A Bread Flavor Enhancer

The new bread flavor enhancer Flavol (16) is an acid hydrolyzate of wheat gluten, which provides a protein-derived mixture of free amino acids plus certain organic acids. The latter lactic and/or acetic acid, which serve to lower the dough pH below 5.4, and trace amounts of soluble salts of butyric, valeric, hexanoic, isobutyric, and isovaleric acids. In comparison to the amino acids present in Flavol the organic acids are available in minute quantities.

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*Flavol is the registered name of a bread flavor enhancer. It is understood that wherever Flavol is mentioned in this manuscript, its registration is implied.

This invention represents an important advance in the art of baking. It involves a process improvement whereby an additive composition incorporated into the dough as it is prepared, fully compensates for the lack of fermentation. Resulting baked products are claimed to have not only equal or better flavor but also equal or better physical properties, with reference to crumb resiliency, texture and grain.

In application, all ingredients can be mixed as in a "straight-dough" or as the second mix in a "sponge-dough." In either case, fermentation may essentially be eliminated. The process may therefore be termed a straight "No-time" dough.

The purpose of this study was to evaluate Flavol by sensory methods. Flavol bread was compared with bread baked by conventional procedures by a sensory evaluation panel.

MATERIALS AND METHODS

After consideration of possible tasting methods and due to the lack of highly trained judges, it was concluded that the best and most applicable procedure for sensory evaluation of bread made with the new process was to use a rank-order test on the basis of preference. A rank-order test was used to determine how several samples differ on the basis of single characteristics. The control was not identified. Judges were presented all samples simultaneously (including control) identified only by codes. Judges were asked to rank all samples in order according to their preference concerning specified characteristics. Analysis of data yielded an average rank score for each sample. This method is defined as a psychometric method that may be used in multiple comparisons where the subject considers all of the samples in a series at the same time and is required to rank them in order of some designated dimension, such as preference, intensity, quality, etc. (7).

Thirteen semi-trained judges were chosen from research assistants, laboratory technicians, graduate students in Food Science, and undergraduate students in Baking Science and Management. The judges had experience in baking and different areas of Food Science.

Loaves of bread were baked on a laboratory scale and allowed to cool for one hour after baking. Loaf volume was not measured prior to judging to avoid the possibility of contaminating bread flavor by rapeseed aroma. Breads were sliced in one-half inch thickness by a commercial slicing machine and one slice immediately placed in each water-proof polyethylene bag and fastened. The bags had been allowed to air for 48 hours before using to remove any inherent odor. The judges received three different samples of bread representing conventional sponge or straight dough procedure, and the K.S.U. "No-time" procedure with two different concentrations of Flavol (0.2% and 0.4%, based on flour weight). The bags containing test slices were coded by three geometrical signs, triangle, square, and circle, but the arrangement was changed for each scoring test. Each series was duplicated on another day.

The conference room in Shellenberger Hall was used for the panel presentation. The judges received samples of the fresh bread, a score card and a guide about some definitions provided by Committee on Sensory Evaluation of the Institute of Food Technologists. The judges were served tap water during tasting and were asked to determine four different characteristics, sweetness, sourness, overall flavor, and overall aroma. They were asked to define their impression according to preference, i.e. 3--most, 2--between, and 1--least. Panel testing was done for five American type bread products which included white pan bread, French bread, American rye bread, wheat bread, and dinner rolls.

White Pan Bread

White bread as defined by the U.S. Department of Agriculture "is the product, in the form of loaves or smaller units, obtained by baking a leavened and kneaded mixture of flour, water, salt, and yeast, with or without edible fat or oil, milk or milk product, sugar and/or other fermentable carbohydrate substance. It may also contain diastatic and/or proteolytic ferments and such minute amounts of unobjectionable salts as serve solely as yeast nutrients. The flour ingredient may include not more than 3 percent of other edible farinaceous substance. White bread should contain, one hour or more after baking, not more than 38 percent of moisture" (31).

Ingredients are listed in Table 1. The conventional procedure used as a control was started by mixing sponge (80°F), followed by four hours fermentation (86°F, 90% R.H.), mixing dough to optimum--20 minutes rest time, molding, panning, proofing to optimum expansion (85°F, 90% R.H., 70 minutes; 1.5 inches of gauge), and baking 25 minutes at 425°F. The K.S.U. "No-time" procedure, in brief, included mixing dough to optimum (86°F), followed by 20 minutes rest time, molding, panning, proofing to optimum expansion (85°F, 90% R.H., 70 minutes; 1.5 inches of gauge), and baking 25 minutes at 425°F. A formula batch consisted of two loaves.

Table 1

Formulas for White Bread

Ingredients	Conventional[a]				K.S.U. "No-time"	
	Sponge		Dough			
	%	gram	%	gram	%	gram
Flour	70	490	30	210	100	700
Yeast	2	14	-	-	3	21
Salt	-	-	2	14	2	14
Sugar	-	-	6	42	6	42
Shortening	-	-	3	21	3	21
MWF[b]	0.5	3.5	-	-	0.5	3.5
Arkady[c]	0.25	1.75	-	-	-	-
Water	44	308	21	147	65	455
Oxidant[d]	-	-	-	-	70 p.p.m.	
Flavol	-	-	-	-	0.2 or 0.4	1.4 2.8

[a]Sponge-dough procedure (control).

[b]Malt wheat flour.

[c]Yeast food.

[d]Bromate and Iodate.

French Bread

Wihlfahrt (31) stated that French bread is made by either the straight or sponge dough method and differs in nearly every shop. In many bakeries it is far from being the genuine article. It requires a semi-tight dough. After the loaves are molded, they are laid smooth side down on cloth-covered boards, with the cloth pinched up between the loaves, and allowed to rest until double in size, then cut and baked with a good supply of heat.

Formulas used for preparing French bread for panel testing are listed in Table 2. The conventional procedure used as a control, in brief, included mixing dough to optimum (80°F), two hours fermentation (86°F, 90% R.H.), rounding, 20 minutes rest time, molding and shaping, proofing to optimum visual expansion (90°F, 90% R.H., 45 minutes), and baking at 400°F for 25 minutes. The K.S.U. "No-time" procedure started by mixing dough to optimum (86°F), followed by 20 minutes resting time, molding and shaping, proofing to optimum

Table 2

Formula for French Bread

Ingredients	Conventional[a]		K.S.U. "No-time"	
	%	gram	%	gram
Flour	100	700	100	700
Yeast	1.75	12.25	3.5	21
Salt	1.5	10.5	1.0	7
Sugar	1.5	10.5	1.0	7
Shortening	2	14	1.0	7
Malt	.5	3.5	1.0	7
Arkady	.5	3.5	-	-
Water	56	392	56	392
Oxidant	-	-	70 p.p.m.	
Flavol	-	-	0.2 or 0.4	1.4 or 2.8

[a]Straight-dough procedure (control).

visual expansion (90°F, 90% R.H., 45 minutes), and baking at 400°F for 25 minutes. Before going to the oven loaves prepared for photography were given an egg wash for shiny crust formation.

Wheat Bread

Wheat bread is a product usually made in the form of loaves or smaller units by mixing 50-70% of whole wheat flour and 30-50% of first clear flour. Formulas used to prepare wheat bread for panel testing are listed in Table 3.

Table 3

Formulas for Wheat Bread

Ingredients	Conventional[a]		K.S.U. "No-time"	
	%	gram	%	gram
Whole wheat	70	490	70	490
White flour	30	210	30	210
Yeast	2	14	2.5	17.5
Sugar	3.5	24.5	4	28
Salt	2	14	2	14
Arkady	.25	1.75	-	-
Malt syrup	2	14	1	7
Shortening	3	21	3	21
Gluten	2	14	2	14
Water	61	427	61	427
Oxidant	-	-	70 p.p.m.	
Flavol	-	-	0.2 or 0.4	1.4 2.8

[a]Straight-dough procedure (control).

Using the conventional method as a control the dough was mixed to optimum (82°F), given two and a half hours fermentation (85°F, 90% R.H.), rounded, given 20 minutes rest time, molded, panned and proofed to optimum visual expansion (100°F, 90% R.H., 50 minutes). The dough was baked for 25 minutes at 420°F. In the K.S.U. "No-time" procedure, the dough was mixed to optimum (86°F), followed by 20 minutes rest time, then molded and panned and proofed to optimum visual expansion (100°F, 90% R.H., 50 minutes). The dough was baked for 25 minutes at 420°F.

<u>American Rye Bread</u>

Wihlfahrt (31) stated that there are many kinds of rye bread made and sold in this country, ranging from dark, sour rye to a very light rye loaf, closely resembling white bread. The type or types of rye bread selling best in one region may be quite different from those demanded in other regions. This naturally depends upon the tastes and customs of the people in each locality.

The flavor of rye bread depends largely on the process of fermentation employed and on the quantity, as well as quality, of the flour used for the blend. Care must be taken to avoid overmixing a rye bread. Ordinarily only about half as much mixing is required as is necessary with a white bread dough. Formulas used for testing are listed in Table 4.

In the conventional method used as a control, ingredients were mixed to optimum (82°F), the dough was fermented (86°F, 90% R.H.) for three hours, then rounded, allowed 20 minutes to rest, molded and shaped, proofed to optimum visual expansion (100°F, 90% R.H., 50 minutes), and baked at 400°F for 25 minutes. In the K.S.U. "No-time" method, ingredients were mixed to optimum (86°F), allowed 20 minutes rest, molded and shaped, proofed to optimum visual

Table 4

Formulas for American Rye Bread

Ingredients	Conventional[a]		K.S.U. "No-time"	
	%	gram	%	gram
White flour	70	490	70	490
Rye flour	30	210	30	210
Yeast	1.5	10.5	2.5	17.5
Salt	2	14	2	14
Malt syrup	1	7	1	7
Shortening	2	14	2	14
Gluten	2	14	2	14
Caraway seed[b]	0.25	1.75	0.25	1.75
Molasses[b]	2	14	2	14
Water	58	406	58	406
Oxidant	-	-	70 p.p.m.	
Flavol	-	-	0.2 or 0.4	1.4 2.8

[a]Straight-dough procedure (control).

[b]Molasses and caraway seed used only for photography.

expansion (100°F, 90% R.H., 50 minutes), and baked at 400°F for 25 minutes. Loaves prepared for photography were given an egg wash for shiny crust formation before being placed in the oven.

Dinner Rolls

Dinner rolls are produced in many types and varieties and are usually served with a meal. They are generally characterized as having a thin, shiny crust, fluffy crumb and sweet taste. Formulas used for panel testing are listed in Table 5.

The conventional method used as a control consisted of blending ingredients and mixing dough to optimum (80°F), allowing two hours for fermentation (86°F and 90% R.H.), rounding, followed by 20 minutes rest time, dividing and shaping, proofing to optimum visual expansion (90°F, 90% R.H., 40 minutes), and baking at 400°F for 15 minutes. The K.S.U. "No-time" procedure consisted of blending ingredients and mixing dough to optimum

Table 5

Formulas for Dinner Rolls

Ingredients	Conventional[a]		K.S.U. "No-time"	
	%	gram	%	gram
Flour	100	700	100	700
Yeast	3.5	24.5	5	35
Salt	2.0	14	2.0	14
Malt	0.5	3.5	0.5	3.5
Sugar	7	49	7	49
NFDM[b]	2.5	17.5	2.5	17.5
Whole eggs	2	-	2	-
Shortening	11	77	11	77
Water	52	364	52	364
Oxidants	-	-	70 p.p.m.	
Flavol	-	-	0.2 or 0.4	1.4 2.8

[a]Straight-dough procedure (control).

[b]Non fat dry milk.

(86°F), followed by 20 minutes rest, dividing and shaping, proofing to optimum visual expansion (90°F, 90% R.H., 40 minutes), and baking at 400°F for 15 minutes.

RESULTS AND DISCUSSION

The Committee on Sensory Evaluation of the Institute of Food Technologists (7) recommended two methods for analysis of data when the test is rank-order: rank analysis or analysis of variance. For this study, analysis of variance was used. All data were analyzed by computer at the Computing Center, Kansas State University using the AARDVARK program. The results will be discussed for each of the baked products, separately.

White Pan Bread

In the sensory evaluation of white pan bread made with Flavol using "No-time" procedure nine semi-trained judges defined their impressions on the basis of preference. The test was conducted twice.

The judges (Table 6) did not define any significant difference in their preference for sweetness, sourness, overall flavor, and overall aroma between

Table 6

Rank-Order Scores for White Pan Bread

Procedures	Sweetness	Sourness	Overall flavor	Overall aroma
Conventional (control)	1.67	1.94	1.94	1.94
K.S.U. "No-time" 0.2% Flavol	1.94	2.11	1.94	2.22
K.S.U. "No-time" 0.4% Flavol	2.06	2.06	2.22	1.83
$L.S.D._{0.05}$	--	--	--	--

white pan bread prepared by the conventional sponge-dough procedure (control) and the K.S.U. "No-time" method using 0.2% and 0.4% Flavol. Regarding physical characteristics (Fig. 1) there were no significant visual differences between bread prepared by the conventional sponge-dough procedure (control) and K.S.U. "No-time" method using 0.2% or 0.4% Flavol.

French Bread

In sensory evaluation of French bread made with Flavol using "No-time" procedure, 12 semi-trained judges defined their impression on the basis of preference. The test was duplicated.

Table 7

Rank-Order Scores for French Bread

Procedure	Sweetness	Sourness	Overall flavor	Overall aroma
Conventional (control)	[a]1.62	2.00	1.92	1.96
K.S.U. "No-time" 0.2% Flavol	2.20	2.25	2.41	2.38
K.S.U. "No-time" 0.4% Flavol	2.13	1.75	1.75	1.67
$L.S.D._{0.05}$	0.39	--	0.37	0.32

[a]A] between two values indicates a significant difference.

As shown in Table 7, the judges did not define a significant preference for sweetness between bread prepared by the K.S.U. "No-time" procedure using 0.2% and 0.4% Flavol. However they did define a significant preference for the bread made with Flavol compared to the conventional straight-dough procedure using two hours fermentation. For sourness, the judges did not define any significant difference between bread made by the conventional

Fig. 1 White pan bread made by conventional sponge-dough process (control) and K.S.U. "No-time" process using 0.2% and 0.4% Flavol.

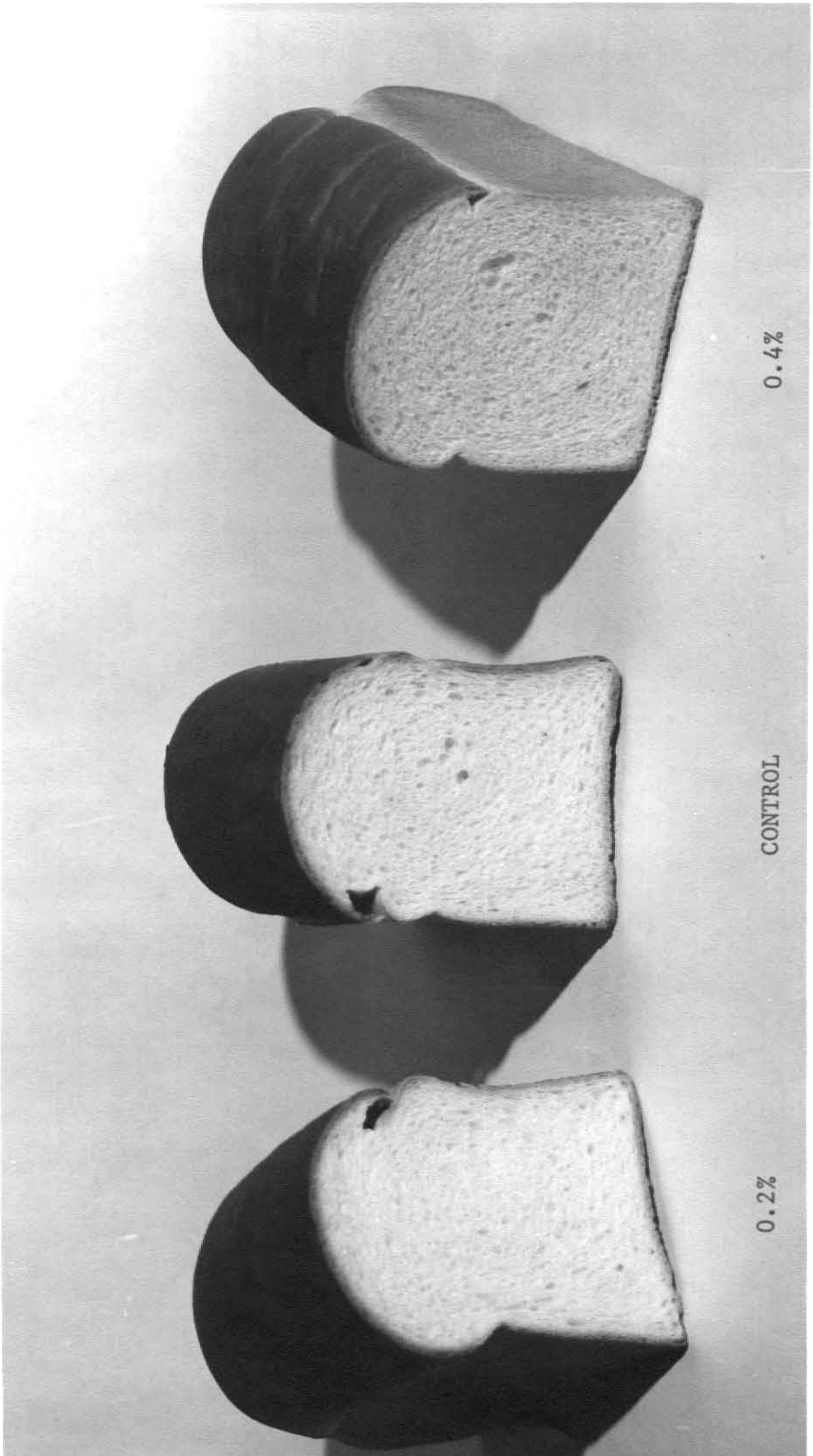


Fig. 1

straight dough procedure or those made with Flavol. Comparing bread for overall flavor and overall aroma, the judges did not define any significant difference between the conventional straight dough procedure and the K.S.U. "No-time" procedure using 0.4% Flavol. But they significantly preferred bread baked with K.S.U. "No-time" procedure using 0.2% Flavol. Regarding physical characteristics of the breads as shown in Figs. 2 and 3, there were no significant visual differences between the conventional straight-dough procedure and the K.S.U. "No-time" method using 0.2% or 0.4% Flavol.

Wheat Bread

In sensory evaluation of wheat bread made with Flavol using K.S.U. "No-time" procedure, 10 semi-trained judges defined their impression on the basis of preference. The test was duplicated.

Table 8

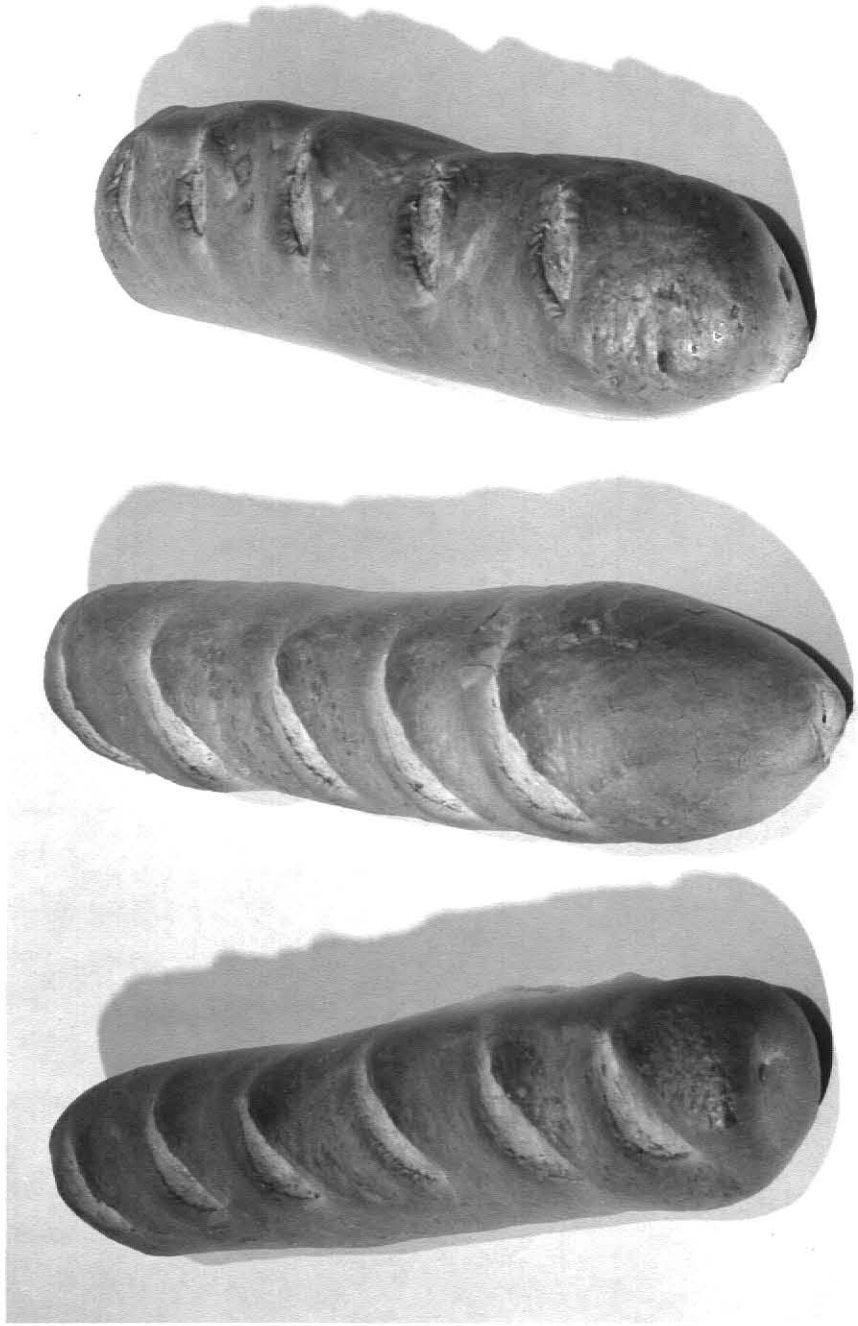
Rank-Order Scores for Wheat Bread

Procedure	Sweetness	Sourness	Overall flavor	Overall aroma
Conventional (control)	2.05	2.05	1.90	1.80
K.S.U. "No-time" 0.2% Flavol	2.40 ┐[a]	2.15	2.00	2.40
K.S.U. "No-time" 0.4% Flavol	1.65 ┘	1.80	1.95	1.70
L.S.D.$_{0.05}$	0.46	--	--	--

[a]A ┐ between two values indicates a significant difference.

As shown in Table 8, the judges did not define any significant difference in preference for sweetness between bread baked by the K.S.U. "No-time" procedure with either 0.2% or 0.4% Flavol and the conventional straight-dough

Fig. 2 French bread made by conventional straight-dough process (control) and K.S.U. "No-time" process using 0.2% and 0.4% Flavol.



0.2% CONTROL 0.4%

Fig. 2

Fig. 3 Sliced French bread made by conventional straight-dough process (control) and K.S.U. "No-time" process using 0.2% and 0.4% Flavol.

0.2% CONTROL 0.4%

Fig. 3

procedure. They significantly preferred sweetness in bread with 0.2% Flavol in comparison to bread with 0.4% Flavol. Comparing sourness, overall flavor, and overall aroma, the judges did not define any significant difference between breads made with Flavol and the conventional method. In regard to physical characteristics, as shown in Fig. 4, there were no significant differences among breads from the three formulas.

<u>American Rye Bread</u>

In sensory evaluation of rye bread made with Flavol using K.S.U. "No-time" procedure, nine semi-trained judges defined their impressions on the basis of preference in two tests.

Table 9

Rank-Order for American Rye Bread

Procedure	Sweetness	Sourness	Overall flavor	Overall aroma
Conventional (control)	2.00	1.89	1.89┐	1.83
K.S.U. "No-time" 0.2% Flavol	2.44┐[a]	2.44┐	2.50┤	2.28
K.S.U. "No-time" 0.4% Flavol	1.56┘	1.67┘	1.61┘	1.89
L.S.D.$_{0.05}$	0.54	0.57	0.51	--

[a]A] between two values indicates a significant difference.

As shown in Table 9, the judges did not define any significant difference in sweetness and sourness between rye bread made by the conventional straight-dough procedure with three hours fermentation and the K.S.U. "No-time" procedure using 0.2% Flavol. They showed a definitely lower preference for bread with 0.4% Flavol compared to that with 0.2% Flavol.

Fig. 4 Wheat bread made by conventional straight-dough process (control) and K.S.U. "No-time" process using 0.2% and 0.4% Fiavol.

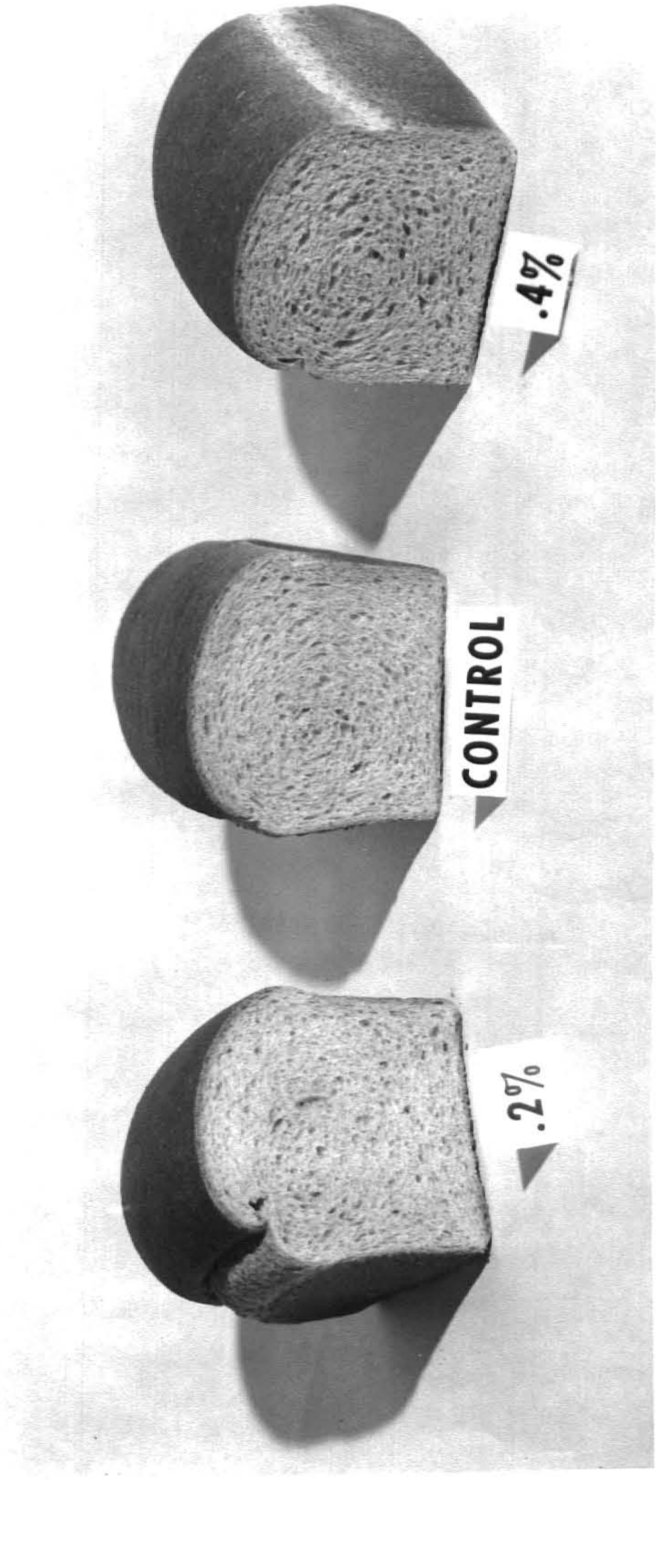


Fig. 4

Regarding overall flavor, the judges significantly preferred bread made by the K.S.U. "No-time" procedure using 0.2% Flavol compared to the bread made with two other formulas. The judges did not define any significant difference in overall aroma among the three breads. The physical characteristics (Figs. 5 and 6) indicated that bread baked by the conventional method had inferior characteristics compared to the breads made by the K.S.U. "No-time" procedure.

Dinner Rolls

In sensory evaluation of dinner rolls made with Flavol using the K.S.U. "No-time" procedure, 10 semi-trained judges defined their impressions on the basis of preference. The test was duplicated.

Table 10

Rank-Order Scores for Dinner Rolls

Procedure	Sweetness	Sourness	Overall flavor	Overall aroma
Conventional (control)	1.80	2.00	2.05	2.15
K.S.U. "No-time" 0.2% Flavol	2.30	2.10	2.15	[a] 2.35
K.S.U. "No-time" 0.4% Flavol	1.90	1.90	1.80	1.50
$L.S.D._{0.05}$	--	--	--	0.50

[a] A] between two values indicates a significant difference.

As indicated in Table 10, the judges did not define any significant difference for sweetness, sourness, and overall flavor between rolls made by the conventional method with two hours fermentation and the K.S.U. "No-time" procedure using 0.2% and 0.4% Flavol. The judges did not define any

Fig. 5 American rye bread made by conventional straight-dough process (control) and K.S.U. "No-time" process using 0.2% and 0.4% Flavol.

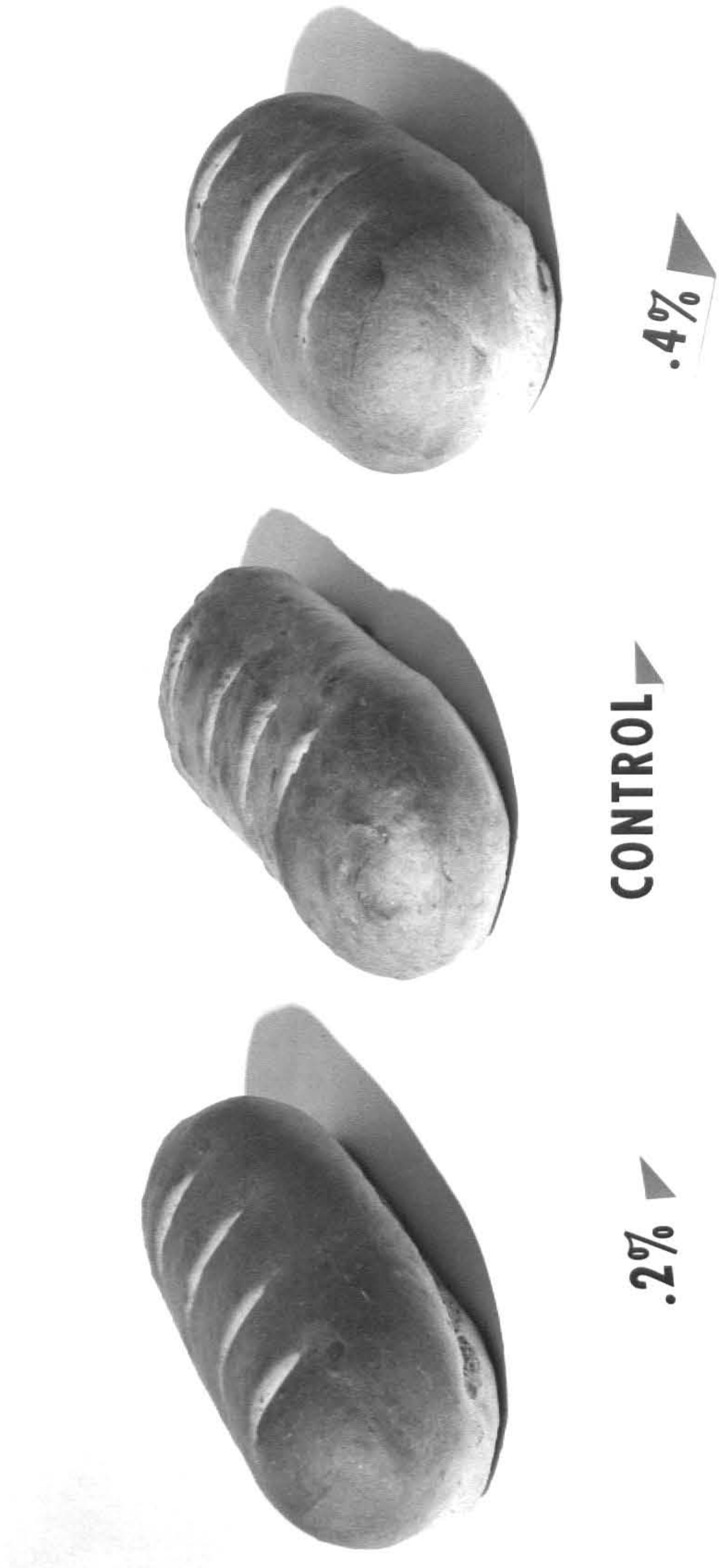


Fig. 5

Fig. 6 Sliced American rye bread made by conventional straight-dough process (control) and K.S.U. "No-time" process using 0.2% and 0.4% Flavol.

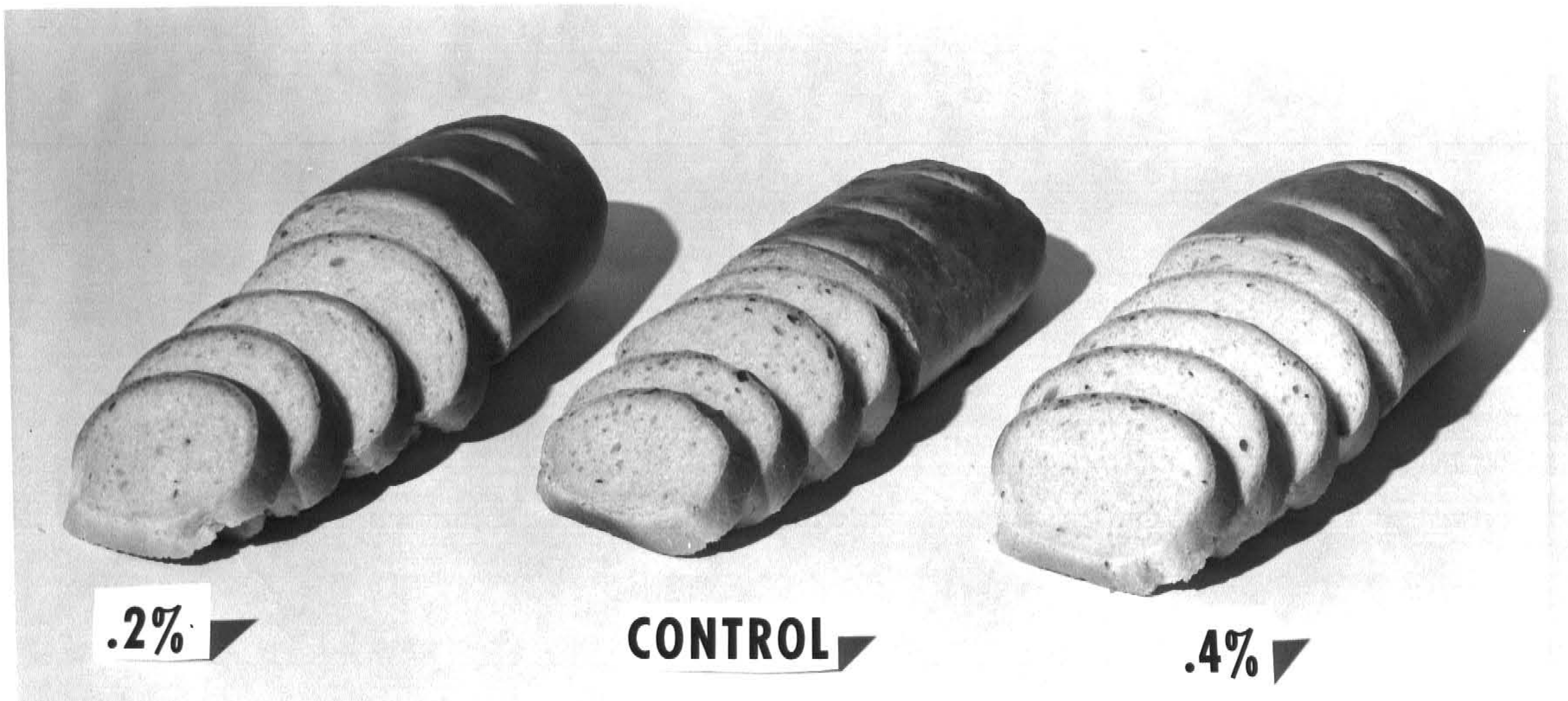


Fig. 6

significant difference in overall aroma between bread made by the conventional straight-dough procedure and the K.S.U. "No-time" procedure using 0.2% Flavol, but there was a significantly lower preference for bread made by the K.S.U. "No-time" method using 0.4% Flavol. The physical characteristics of the dinner rolls made by the three formulas showed no significant visual differences (Figs. 7 and 8).

SUMMARY AND CONCLUSIONS

Sensory evaluations were made of breads made by conventional sponge-dough or straight-dough procedure and those made by the new K.S.U. "No-time" process using two concentrations of the bread flavor enhancer, Flavol. Evaluations were made by semi-trained judges of white pan breads, French breads, American rye breads, wheat breads and white dinner rolls. A rank-order test for sweetness, sourness, overall aroma and overall flavor was used. All tests were conducted in duplicate. All data were analyzed by computer for variance using the AARDVARK program.

The preference results showed that all types of breads made with 0.2% Flavol were comparable or occasionally superior in sweetness, sourness, overall aroma and overall flavor to the same breads made by conventional sponge-dough or straight-dough procedure. Breads made with 0.4% Flavol compared to breads made with 0.2% Flavol or conventional sponge-dough or straight-dough procedures proved to be equal or occasionally inferior in all factors used in sensory evaluation of the breads.

The physical characteristics of the breads made by the new K.S.U. "No-time" process were very similar to those made by the conventional process. These results suggest that a commercial baker should be able to

Fig. 7 Dinner rolls made by conventional straight-dough process (control) and K.S.U. "No-time" process using 0.2% and 0.4% Flavol.

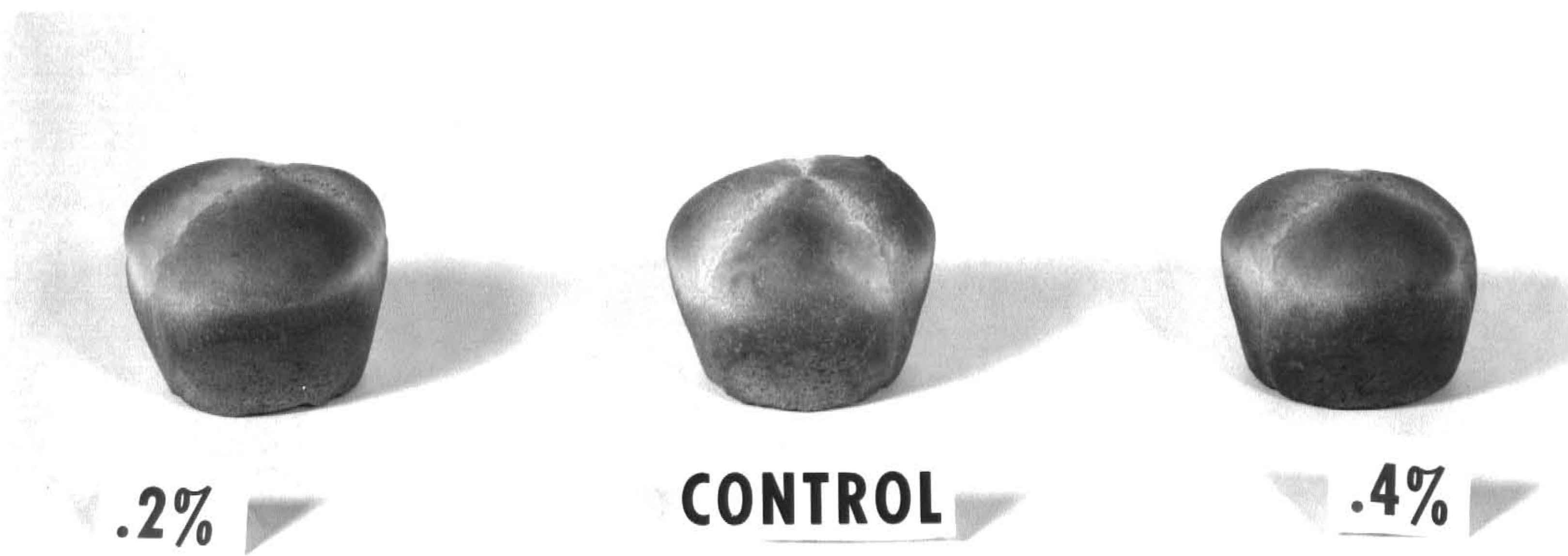


Fig. 7

Fig. 8 Sliced dinner rolls made by conventional straight-dough process (control) and K.S.U. "No-time" process using 0.2% and 0.4% Flavol.

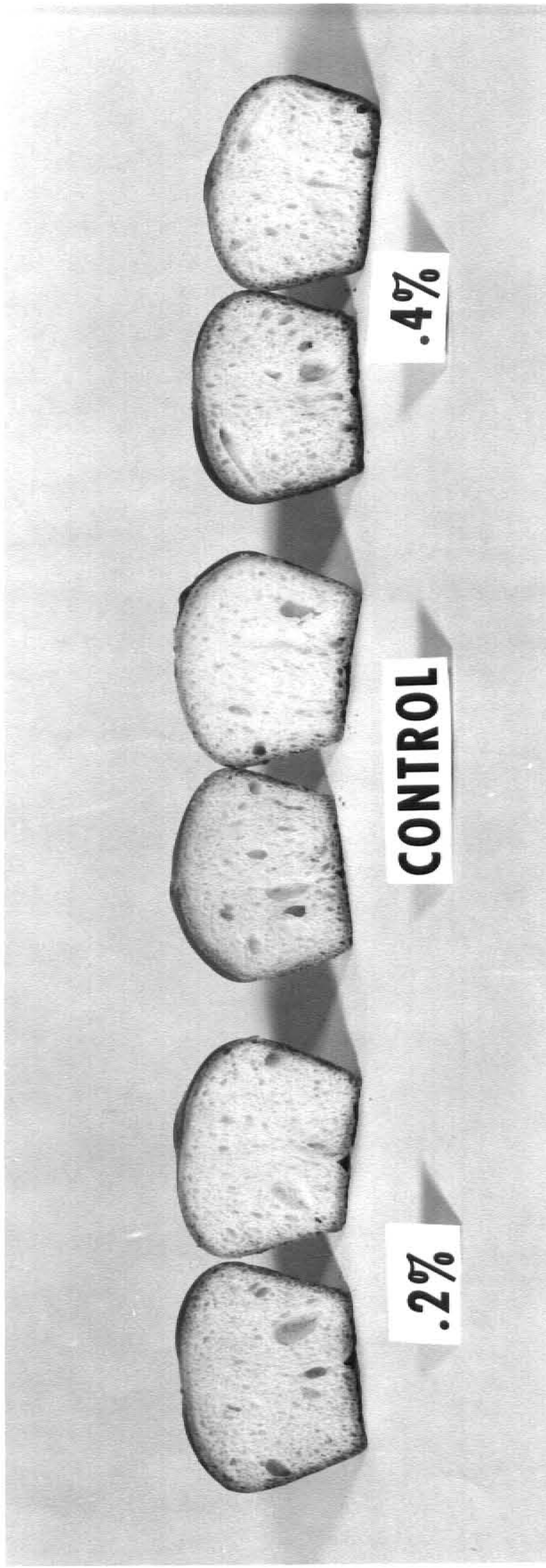


Fig. 8

obtain bread of equal quality by the two processes. From these studies, a level of 0.2% of the Flavol based on flour weight is recommended for all products used in this investigation.

ACKNOWLEDGMENTS

The author wishes to express his gratitude to Dr. John A. Johnson, major professor, for his invaluable guidance and encouragement throughout the course of this study and preparation of this manuscript. Gratitude is extended to Dr. Jean F. Caul (Department of Foods and Nutrition), the supervisory committee, Mr. Carlos R. S. Sanchez (Instructor of Baking) and to 13 nice people who served as semi-trained judges during the course of this investigation.

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SENSORY EVALUATION OF FLAVOL

by

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B. S., Pahlavi University, Shiraz, Iran, 1969

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

in

FOOD SCIENCE

Department of Grain Science and Industry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1973

Sensory evaluations were made of breads made by conventional sponge-dough or straight-dough procedures and those made by the new K.S.U. "No-time" process using two concentrations of the bread flavor enhancer, Flavol.* Evaluations were made by semi-trained judges who were chosen from research assistants, laboratory technicians, graduate students in Food Science, and undergraduate students in Baking Science and Management. Panel testing was done for five American type baked products which included white pan bread, French bread, American rye bread, wheat bread, and dinner rolls. A rank-order test on the basis of preference was used. All tests were conducted in duplicate. All data were analyzed for variance using the AARDVARK program on the computer.

The preference results showed that all types of bread made with 0.2% Flavol were comparable or occasionally superior in sweetness, sourness, overall flavor and overall aroma to the same breads made by conventional sponge-dough or straight-dough procedures.

Bread made with 0.4% Flavol compared to breads made with 0.2% Flavol or conventional sponge-dough or straight-dough procedures proved to be equal or occasionally inferior in all factors used in sensory evaluations of the breads.

The physical characteristics of the breads made by the new K.S.U. "No-time" process were very similar to those made by the conventional process. These results suggest that a commercial baker should be able to obtain bread of equal quality by the two processes. From these studies, a

*Flavol is the registered name of a bread flavor enhancer. It is understood that wherever Flavol is mentioned in this abstract, its registration is implied.

level of 0.2% of the Flavol based on flour weight is recommended for all products used in this investigation.