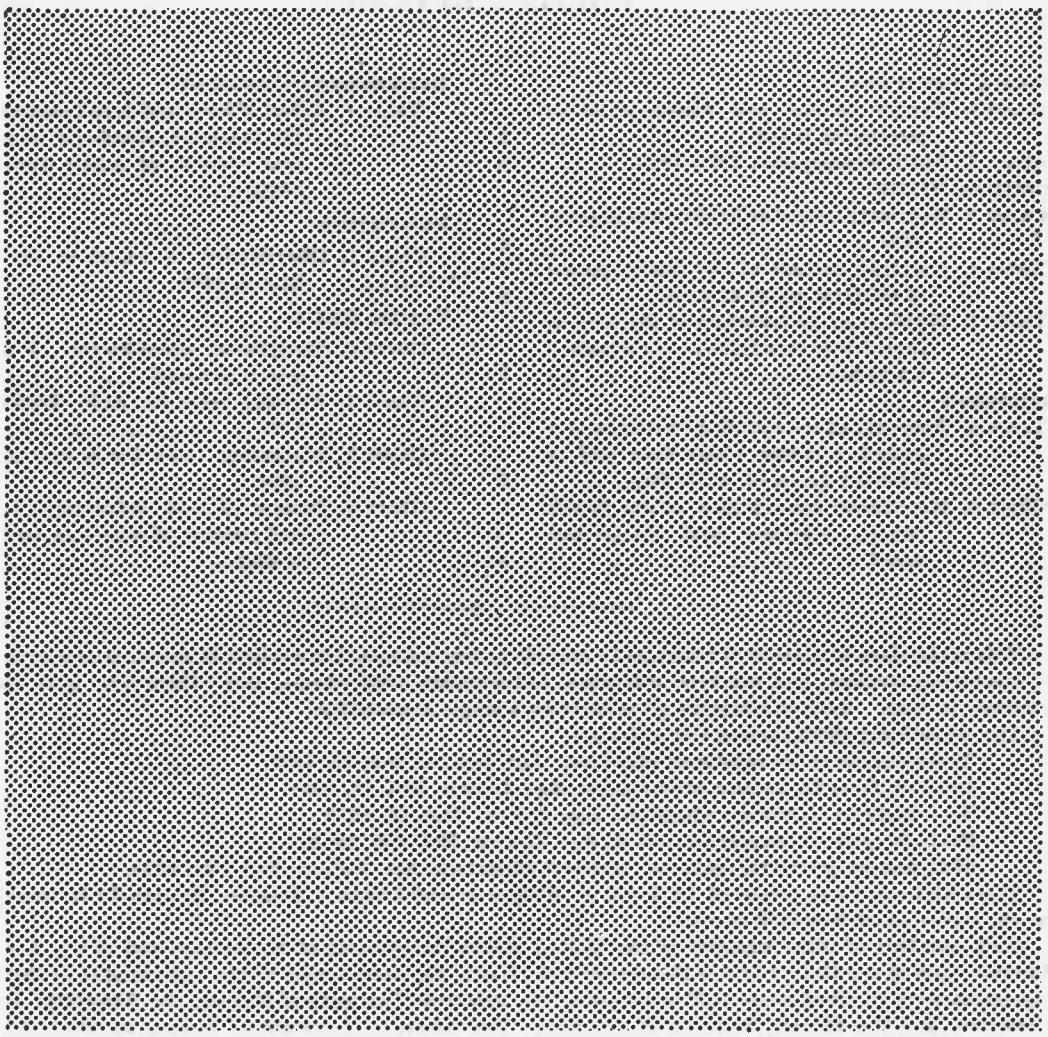
BREAD

facts for consumer education



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Contents

Charts and tables

This is the sixth of a series of bulletins to provide source material for workers in extension, consumer education, and marketing services, and teachers, dietitians, nutritionists, food editors, and others who give consumers information on food. Each publication gives facts on a single commodity.

The other five publications of the series are:

Tomatoes, facts for consumer education, Agr. Inform. Bul. 32, 1951.
Peaches, facts for consumer education, Agr. Inform. Bul. 54, 1951.
Beef, facts for consumer education, Agr. Inform. Bul. 84, 1952.
Pork, facts for consumer education, Agr. Inform. Bul. 109, 1954.
Milk and its products, facts for consumer education, Agr. Inform. Bul. 125, 1954.

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Staff members of other agencies of the United States Department of Agriculture and of the Food and Drug Administration of the United States Department of Health, Education, and Welfare cooperated in the preparation. Suggestions were received from staff members of the American Institute of Baking, the Associated Retail Bakers of America, and the Millers' National Federation. The American Institute of Baking supplied the pictures on how bread is made.

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BREAD . . . facts for consumer education

Though there are other kinds of bread on the market, this bulletin deals with yeast-leavened, commercial bread available to consumers in the United States today.

Breadmaking has moved from the home into commercial bakeries, where it is made by large-scale, mechanical operations. About 40 million loaves are produced daily, mainly for local distribution.

Ingredients and methods have been standardized and improvements made through research. Nutritive values in much of the commercial white bread have been increased by the use of milk as an ingredient and by enrichment with three B-vitamins and iron.

Since early in man's history wheat has been cultivated for breadmaking. Our present-day bread has developed from the leavened wheat bread which, according to early records, was first made by the Egyptians.

Bread consumption

In a 1948 survey of urban families (*3*),[1] nearly all reported that they had purchased bread during the week under study. The average amount of commercial, yeast-leavened bread purchased was 6 pounds—or about ¼ pound (approximately 5 slices) per person per day. An average sum of 93 cents per family was spent for bread during the week—or 4 percent of the total food budget.

More bread was purchased by families in the middle-income groups than by those in either the high- or low-income groups. (See chart 1.) White bread was used in greatest quantity by all the families. Other breads, such as cracked wheat, whole wheat, raisin, and rye, were used in greater quantities by the families in the higher income groups. Purchases of bread of different types and the percentage of households using each kind in a week are as follows:

Bread:	Pounds purchased per week	Percent of households using
All kinds	6.14	98
White, enriched	4.69	86
White, unenriched	.21	3
Whole wheat	.56	22
Cracked wheat, raisin, rye	.68	29

The trend toward purchasing bread rather than making it in the home varies with the type of community and with the region of the country. A survey of four cities in 1948 (*3*) showed that Birmingham, Ala., families consumed less bread but more flour than families in Buffalo, N. Y., Minneapolis-St. Paul, Minn., and San Francisco, Calif. The Birmingham families used flour for hot quick breads, which are served frequently in the South.

Consumption of flour and cereal products in the United States has declined greatly in the last 40 years, as shown in chart 2. With higher incomes and larger food budgets, consumers are using less flour and cereal products and potatoes, and more fruits and vegetables, eggs, meat, poultry, and fish, dairy products (except butter), and sugars and sirups.

Regulations and standards

Regulations and standards for bread are embodied in Federal, State, and local laws. State and local laws and their enforcement vary greatly but are concerned mainly with cleanliness and sanitation in baking and handling bread, weight standards and labeling of the loaves, and enrichment of the bread. Enrichment of white bread is mandatory in 26 States, Hawaii, and Puerto Rico (*6*). The various State requirements for enrichment are the same as or similar to those in the Federal standards.

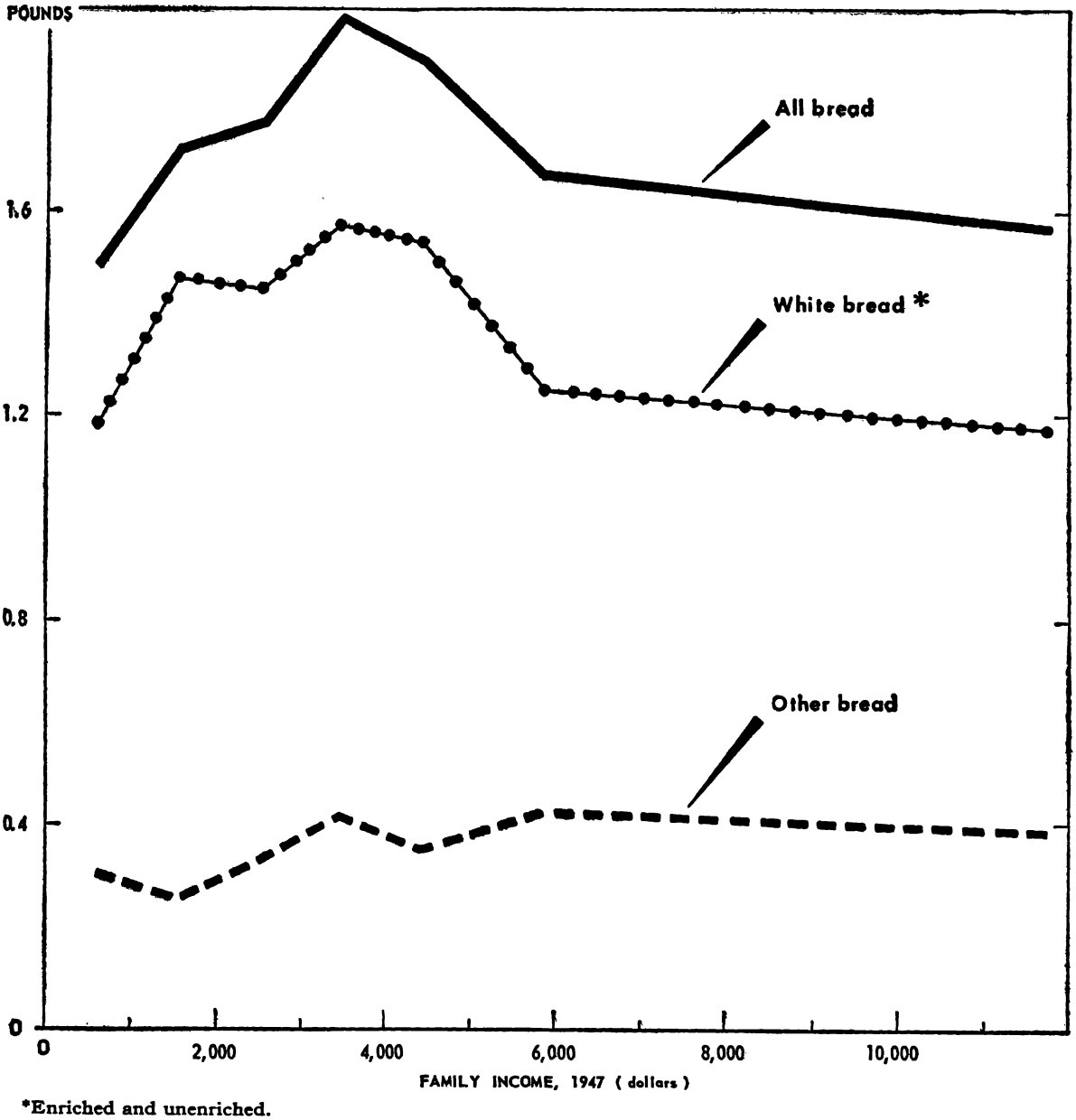
When bread is transported across State lines, it is subject to Federal law. The trend toward larger bakeries with transportation of bread over longer distances is bringing more bread under Federal regulations.

[1] Italic numbers in parentheses refer to References Cited, p. 20.

Chart 1

FAMILY INCOME AND CONSUMPTION OF PURCHASED BREAD

Per Person in a Week By City Families, Spring 1948



*Enriched and unenriched.

Source: Food Consumption of Urban Families in the United States (*2*).

Federal definitions and standards were established for five kinds of commercial bread effective August 1952, under the Federal Food, Drug, and Cosmetic Act (*4*). These breads, known as standardized breads, are white bread, enriched bread, milk bread, raisin bread, and whole wheat bread.

Although the Federal legislation applies only to bread shipped interstate, some States have adopted the Federal standards for bread. Members of the baking industry helped to formulate the bread standards and much of the bread is made in conformity with them on a voluntary basis.

Federal definitions and standards for bread specify basic ingredients, establish minimum loaf weights, and require 62 percent minimum solids content, thereby setting a maximum of 38 percent moisture content.

The use of any spices or chemical preservatives, such as those used as mold and rope inhibitors, must be specified on the label for both standardized and other breads.

Breads not standardized, such as rye or cracked wheat, must show, in addition to spices or chemical preservatives, a complete list of ingredients on their labels. These breads must contain a sufficient amount of the principal ingredient to identify them by flavor, color, or texture, as specialty breads and to distinguish them from the standardized breads.

Kinds of bread

The term "bread" unqualified refers to white bread made of wheat flour. Other kinds of bread have a descriptive title preceding the term "bread," such as rye, whole wheat, or raisin.

The Federal definitions and standards of identity for the five standardized breads are summarized below. Also included are the characteristics of some common types of bread for which definitions and standards of identity have not been established.

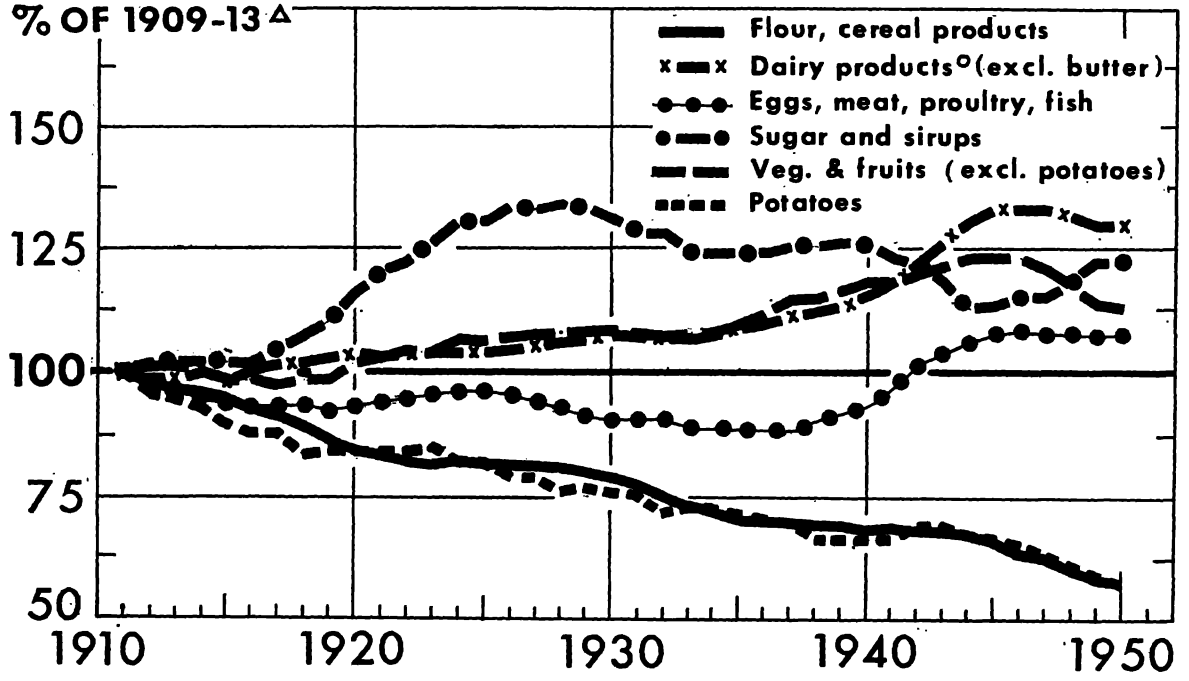
Standardized breads

White bread must contain four basic ingredients: Flour, water or other specified liquid ingredients, salt, and yeast.

Other ingredients are optional and may be one or more of the following: Shortening; milk; buttermilk, whey, milk proteins; eggs; sugar, sirup, or molasses (except blackstrap); malt sirup or malted wheat or barley flour; harmless lactic acid bacteria; corn flour, potato flour, soy flour, and other specified flours and starches; ground dehulled soybeans; various specified mineral salts, yeast foods, dough conditioners, or bread improvers; various specified mold and

Chart 2

FOOD CONSUMPTION, 1909-1952*



Δ5-year moving average.
°In terms of milk equivalent.
*Food available per person for civilian consumption at the retail level.
Source: Consumption of Food in the United States, 1909–1952 (*1*).

rope inhibitors; and spice. Quantities of some of the optional ingredients are limited according to the amount of flour used. See Ingredients, p. 10.

The quantity of whole milk or its equivalent used in white bread is limited to less than 100 percent of the total liquid used. When the total liquid is whole milk or its equivalent, the resulting product is labeled "milk bread." See Milk bread, p. 4.

In addition to plain white breads, other white breads to which these standards apply include French, Italian, and vienna breads. French, Italian, and vienna breads are made from strong, high-protein flours with small amounts of yeast and a long fermentation period. They are baked on the hearth rather than in pans. Moisture from steam in the oven gives the loaves a thick, crisp crust. The French style is a long thin loaf; the vienna is a long loaf but fuller, with pointed ends; the Italian loaf may be long or it may be rounded.

Standards for enriched, milk, raisin, and whole wheat breads must conform to those for white bread with the following exceptions:

Enriched bread is required to contain specified amounts of three B-vitamins—thiamine, riboflavin, niacin—and iron. See Enrichment, p. 8.

The label on enriched bread must state percentages of the minimum daily requirements of thiamine, riboflavin, and iron, and the milligrams of niacin provided by one-half pound or other quantity of the bread (*5*). The minimum daily requirements are those promulgated by the Food and Drug Administration. An example of a dietary statement on enrichment on a bread label follows.

DIETARY STATEMENT ON ENRICHMENT ON BREAD LABEL

One-half pound of this bread supplies the following amounts or percentages of your minimum daily requirement for these essential food substances: THIAMINE (Vitamin B_1) 55%; RIBOFLAVIN (Vitamin B_2) 17.5%; NIACIN (another "B" vitamin) 5 milligrams; IRON 40%.

Enriched bread may also contain in each pound from 150 to 750 U. S. P. units of vitamin D and from 300 to 800 mg. of calcium. Wheat germ, in an amount equal to not more than 5 percent of the total flour, may be added. There is no quantity limitation on milk products used as ingredients.

The terms "enriched bread" or "enriched rolls" may be used solely to specify white bread or rolls that have been enriched in accordance with Food and Drug Administration standards. The two words must be used together with no word between.

Milk bread must be made from whole milk or from water and the equivalent whole milk solids as the sole moistening ingredient. Buttermilk, whey, and milk proteins may not be used as part of the milk in milk bread.

Raisin bread must contain at least 50 pounds of raisins per 100 pounds of flour. The optional use of icing, and of water extract of raisins is permitted. Raisin bread may be made with milk.

Whole wheat bread (graham, entire wheat) must be made with whole wheat flour as the only farinaceous ingredient; it has no quantity limitation on milk ingredients, but has a higher permissible maximum for certain mold and rope inhibitors.

Breads not standarized

Some of the common breads on the consumer market that are not standardized are described below.

Pumpernickel bread is a type of rye bread that has a sour flavor. It is made from a sour dough prepared with dark rye flour and acid-producing bacteria. After fermenting for 18 to 24 hours, the sour dough is combined with additional rye flour and liquid into a sponge and allowed to ferment for 4 to 8 hours. Rye meal, yeast, and other ingredients are then added and it is made into bread. Pumpernickel is compact and dark in color. The loaves are either large and round or small and long.

American rye bread is usually lighter colored and milder flavored than the dark, sour-dough types. It is made with yeast and light rye flour and wheat flour. Caraway seeds are sometimes added to the dough and to the top of the loaf. It is often made of half rye and half wheat flour.

Wheat or wheaten bread is made from a combination of whole wheat and white flours. The consumer sometimes mistakes it for whole wheat or graham bread. The name "wheat bread" is permitted by the Federal Food and Drug Administration provided the label shows

clearly, according to specified wording, that the bread contains both white and whole wheat flour.

The proportions of whole wheat and white flour in breads of this type vary. One formula for wheat bread contains 35 percent of whole wheat flour and 65 percent of white flour (*8*); others may contain equal quantities of the two flours or a higher proportion of whole wheat to white flour. The flour used in greatest proportion is listed first in the ingredients on the label.

Cracked wheat bread is made from a combination of cracked wheat and white flour; whole wheat flour may also be added. The proportion of cracked wheat to white flour varies. One formula contains 10 percent of cracked wheat, 10 percent of whole wheat flour, and 80 percent of white flour.

Cracked wheat is prepared by cracking and crushing the wheat to produce meal which retains most of the bran.

Potato bread contains more than 3 parts of potato flour to 100 pounds of white flour (the proportion allowed in white bread). It usually takes from 6 to 8 parts of potato flour to each 100 pounds of flour to give the characteristics of potato bread (*7*). Boiled potatoes can be used instead of potato flour.

Gluten bread, made from gluten flour, is used in special diets in which starch is kept low or eliminated entirely. Gluten flour is prepared in such a way that it contains a high proportion of protein (mostly gluten) and a low proportion of starch.

Special breads known as *wheat-and-soya* breads contain varying amounts of soy flour. The proportion is more than three parts of soy flour to 100 parts of flour; one formula contains six parts of soy flour to 100 parts of white flour. Soy flour is added primarily to increase the protein content. Some of these breads have other added ingredients of high nutrient content, such as wheat germ and nonfat milk solids.

Nutritive value

Although some people think of bread chiefly as an energy food, it is an important source of a number of essential nutrients.

Because bread is widely used in substantial quantities, it is an economical source of food energy and of protein and when enriched furnishes significant quantities of iron and three B-vitamins. (See Enrichment, p. 8.) The proteins of flour, present in considerable amounts in breads, are better utilized by the body when eaten with proteins from such foods as milk, eggs, and meat.

In 1953 flour and cereals contributed almost one-third of the total thiamine in the national food supply, about one-fourth of the niacin and iron, one-fifth of the protein and food energy, and almost one-seventh of the riboflavin. (See chart 3.) Flour (used mainly for the production of bread) made up approximately three-fourths of the flour and cereals group.

As shown by the nutrient content of various breads (table 1), enriched bread provides iron, thiamine, and niacin in amounts that approach those of whole wheat bread; riboflavin levels in enriched bread are slightly higher than those in whole wheat bread. Whole wheat bread is higher in some of the other known nutrients and possibly in others still to be identified. However, studies indicate that white bread made from highly milled flour has a somewhat higher rate of digestibility than bread made from less refined or from whole grain flour (*13*).

In addition to the increased thiamine, riboflavin, niacin, and iron due to enrichment, the use of milk solids also adds to the nutrient content of bread. Milk solids contribute calcium, riboflavin, and high-quality protein. Milk protein supplements the wheat protein and thus improves the quality of the protein in the bread. The protein of wheat, although present in considerable amount, is relatively low in some of the amino acids essential for human growth and development.

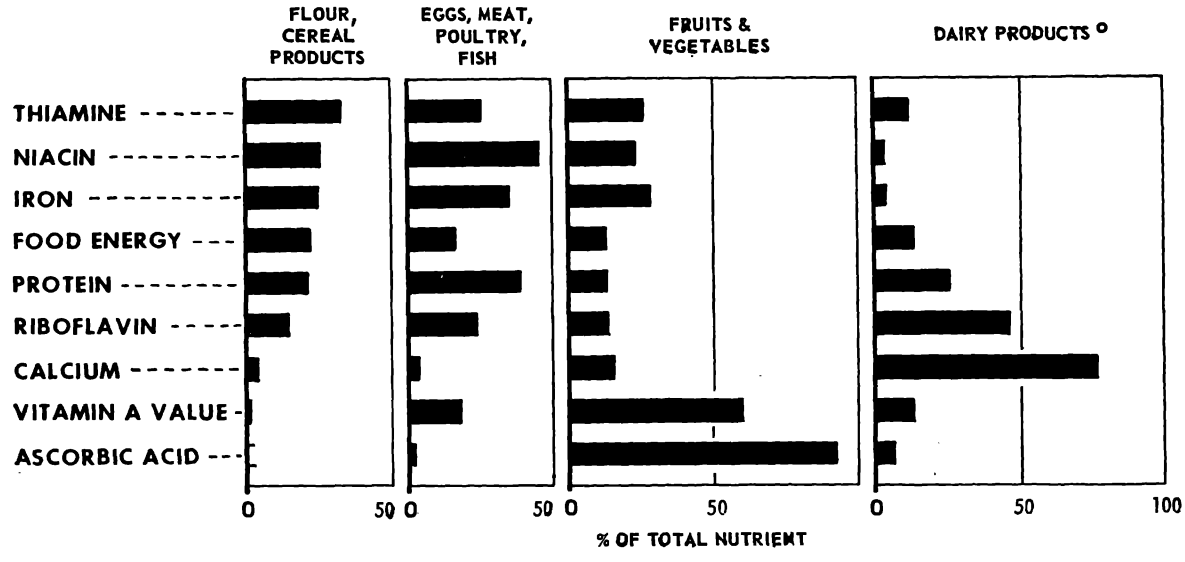
When enriched bread is made with milk rather than water it is higher in calcium but not riboflavin, because enrichment standards are met by adding just enough riboflavin in the enrichment process to supplement that furnished by the milk. The low calcium of French and vienna breads as shown in table 1 is due to the fact that these breads contain little or no milk.

The equivalents of fluid skim milk in bread made with 4, 6, and 10 percent of nonfat dry milk solids would be about ½ cup, ¾ cup, and 1⅛ cups, respectively, for a 1-pound loaf; or ⅛ cup, ⅛ cup, and 3/10 cup, respectively, for ¼ pound or approximately 5 slices of bread.

Chart 3

NUTRIENTS AVAILABLE IN THE FOOD SUPPLY, 1953 *

Contributions of Four Major Food Groups



*United States Civilian Consumption.
°Excluding butter.
Source: Consumption of Food in the United States, 1909–1952 (*1*).

Table 1.—*Nutrient content* [1] *of one-fourth pound of different kinds of bread* [2]

Kinds of bread	Food energy	Protein	Fat	Calcium	Iron	Thiamine	Ribo-flavin	Niacin
Bread, white:								
Enriched—								
Nonfat milk solids added—	*Calories*	*Gm.*	*Gm.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
2 percent	315	9.3	3.8	74	2.0	0.28	0.18	2.5
4 percent	315	9.6	3.6	90	2.0	.28	.18	2.5
6 percent	315	9.8	3.5	104	2.0	.28	.18	2.5
Not enriched—								
Nonfat milk solids added—								
2 percent	315	9.3	3.8	74	.7	.06	.10	1.0
4 percent	315	9.6	3.6	90	.7	.06	.12	1.0
6 percent	315	9.8	3.5	104	.7	.06	.14	1.0
French or vienna:								
Enriched	305	9.2	3.1	27	2.0	.28	.18	2.5
Not enriched	305	9.2	3.1	27	.8	.05	.07	1.0
Raisin	320	8.0	3.5	91	1.5	.08	.12	1.0
Whole wheat	275	10.6	3.0	109	2.5	.34	.15	3.4
Cracked wheat	295	9.6	2.5	94	1.1	.12	.11	1.6
Rye (American type)	280	10.3	1.4	82	1.8	.20	.09	1.7

[1] Values for nutrients are approximate and may vary with differences in kind and amounts of ingredients used in the bread formula.

[2] Approximately 5 slices of bread ½ inch thick weighing 23 grams each.

Source: Composition of Foods . . . Raw, Processed, Prepared (*11*).

Most bread contains calcium from sources in addition to that from milk. Bread formulas may include calcium-containing substances in the form of mold inhibitors, dough conditioners, and yeast nutrients. Calcium salts may also be added as an optional enrichment agent (see page 4). However, the calcium content of bread varies considerably. In a recent study in which about 400 samples of commercial bread were analyzed, the calcium ranged from 54 to 694 milligrams per pound, with an average of 334 milligrams (*10*).

Special breads with higher nutritive content, particularly calcium and high-quality protein, have been developed primarily for use in school lunch programs, and in hospitals and other institutions. Some of the following ingredients are included in their formulas: Whole wheat flour, wheat germ, soy flour, brewer's yeast, and increased quantities of nonfat dry milk solids (*9, 12*).

The nutritive content of baked bread per pound depends not only on the kind and quantity of ingredients used, but on the resulting yield of baked bread. The development of bread formulas requires careful adjustment of ingredients to produce a loaf with the desired level of the various nutrients as well as a loaf acceptable in appearance, palatability, and texture. For example, when the quantity of dry milk solids for a specified amount of flour is increased in a bread dough, the quantity of water is also increased, resulting in a larger yield of baked bread. The calcium and protein content per loaf of this bread will be increased, but that of thiamine and other nutrients may be decreased, owing to the greater number of loaves produced.

Table 2 shows the nutritional contributions of each ingredient in a formula for enriched bread made with 4 percent nonfat milk solids. For more information about ingredients in bread, see Ingredients used, p. 10.

Some thiamine is lost when bread is toasted, the losses varying with the kind of bread and with the amount of toasting. In toast made

Table 2.—*Nutritional contribution of the various ingredients in a formula for enriched white bread*

Ingredient	Quantity in pounds	Food energy	Protein	Fat	Carbohydrate	Calcium	Iron	Thiamine	Riboflavin	Niacin
		Percentage of total nutrient contributed								
Flour, unenriched plus enrichment wafer	100	83.0	87.0	21.4	90.0	12.6	95.9	94.7	62.8	84.8
Water	64	.....	.....	.....	.....	.9	.....	.....	.....	.....
Salt	2	.....	.....	.....	.....	(1)	.....	.....	.....	.....
Yeast	2	.4	2.0	.2	.3	.4	3.2	1.7	12.4	13.2
Sugar	5	4.4	.....	.....	6.0	.....	.....	.....	.....	.....
Shortening	4	8.0	.....	77.6	.....	.....	.....	.....	.....	.....
Nonfat dry milk solids	4	3.3	10.5	.8	2.5	40.8	.8	2.7	23.5	1.1
Malt	1	.8	.5	0	1.1	.....	.....	.9	1.3	.8
Dough conditioner	.25	.1	.1	(1)	.1	14.4	(1)	(1)	(1)	(1)
Mold inhibitor (calcium propionate)	.20	.....	.....	.....	.....	30.8	.....	.....	.....	.....
		Total nutrient contributed								
Total quantity of nutrients (before baking)	.....	*Calories* 199,613.0	*Gm.* 6,163.0	*Gm.* 2,338.0	*Gm.* 37,626.2	*Mg.* 57,816	*Mg.* 1,365.1	*Mg.* 237.69	*Mg.* 151.33	*Mg.* 1,933.0

[1] 0.05 percent or less.

Source: Unpublished data of the Household Economics Research Branch, Agricultural Research Service.

from enriched bread, losses of thiamine ranged from 5 percent for 30 seconds' toasting to 17 percent for 70 seconds' toasting (*14*).

Bread has a place in the well-balanced diet, including the reducing diet. The fact that five slices of white bread supply only 10 percent of the calories recommended for a man 25 years of age (National Research Council recommended allowances) indicates that bread should not be considered a high calorie food. A slice of white bread one half inch thick (23 grams) furnishes 63 calories. A pat of butter or margarine adds 50 calories. Most desserts contribute many more calories to a meal.

Enrichment

Enriched bread is white bread containing specified amounts of iron and the B-vitamins—thiamine, riboflavin, and niacin.

Because most consumers prefer white bread to bread made from natural whole wheat grain, the enrichment of white bread and white flour is of value. As pointed out under Nutritive Value, p. 5, the addition of four important nutrients—thiamine, riboflavin, niacin, and iron—lost when wheat is milled into white flour, brings white bread closer to the level of whole wheat bread in nutritive value, with riboflavin content slightly higher.

Amounts of six nutrients in whole wheat flour and in different types of enriched and unenriched white flour are shown in table 3. The white flours include straight flour which is a combination of all mill streams for white flour, patent flour made from the more highly refined streams, and bread flour made from hard wheat. Family or all-purpose flour is a blend of soft and hard wheat.

The enrichment program was undertaken to increase the thiamine, riboflavin, niacin, and iron in the national diet, because prewar studies had indicated that the average American diet was low in these nutrients. Flour and bread were selected for enrichment, because they are inexpensive, staple foods eaten daily by practically everyone and in generous quantities by low-income families whose diets are most in need of improvement in these respects. Moreover, the enriching nutrients can be added to flour and bread without changing the flavor or physical characteristics.

Table 3.—*Amounts of six specified nutrients in 1 pound of whole wheat flour and of different types of white flour*

Flour	Protein	Calcium	Iron	Thiamine	Riboflavin	Niacin
	Gm.	*Mg.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Whole wheat (100 percent)	60.4	186	15.0	2.49	0.54	19.7
White, straight, hard wheat	53.6	91	6.4	.53	.32	6.5
Not enriched						
Patent: Bread	53.6	73	4.1	0.35	0.25	4.4
Patent: Family or all-purpose	47.7	73	3.6	.28	.21	4.1
Enriched						
Patent: Bread	53.6	73	13.0	2.00	1.20	16.0
Patent: Family or all-purpose	47.7	73	13.0	2.00	1.20	16.0

Source: Composition of Foods . . . Raw, Processed, Prepared (*11*).

The enrichment of flour and bread was largely on a voluntary basis from 1941 until January 1943, when the enrichment of bread was made mandatory under War Food Order No. 1. At the end of the war this order was withdrawn (October 1946). During this period (1943–1946), considerable amounts of white flour for home use were enriched voluntarily. Laws requiring enrichment of white bread and white flour were enacted in 26 States, Hawaii, and Puerto Rico, in which over half of the United States population lives. In the other States enrichment is practiced by many bakers on a voluntary basis. It is estimated that at least 80 percent of today's commercial white bread is enriched (*21*).

Enriched bread and rolls are made by using enriched flour or by adding the enriching substances to the dough. The latter method is more common. Minimum and maximum levels of the nutrients required for enrichment of

bread (or rolls) and flour, as set forth in the Federal standards (*4*, *22*), are as follows:

	Enriched bread, rolls	Enriched flour
Thiamine.....mg. per pound..	1.1– 1.8	2.0– 2.5
Riboflavin.....do....	0.7– 1.6	1.2– 1.5
Niacin.....do....	10.0–15.0	16.0–20.0
Iron.....do....	8.0–12.5	13.0–16.5

Since enrichment has become effective, vitamin B deficiencies have virtually disappeared among patients in nutrition clinics (*17*, *19*). In fact, some medical scientists consider the enrichment of foods as important to the public health as the compulsory pasteurization of milk (*16*) and the correction of unsafe water supplies (*18*).

A comparison of the contributions of enriched and unenriched bread to a day's recommended allowances (National Research Council) of the four nutrients required to be added through enrichment is given in chart 4.

In a survey of urban families in 1948 the amounts of flour and bread consumed by families at different income levels were reported (*2*). Calculation of the nutrient content of these dietaries shows that enrichment of flour and bread has added more of these nutrients to the low-income diets than to those of the higher income groups. (See table 4.)

Estimates of the nutrient content of the national food supply show that increased amounts of thiamine, riboflavin, niacin, and iron have been available in the years since the enrichment program went into effect (*1*).

Table 4.—*Effect of flour and bread enrichment on the thiamine, riboflavin, niacin, and iron content of urban diets, spring 1948*

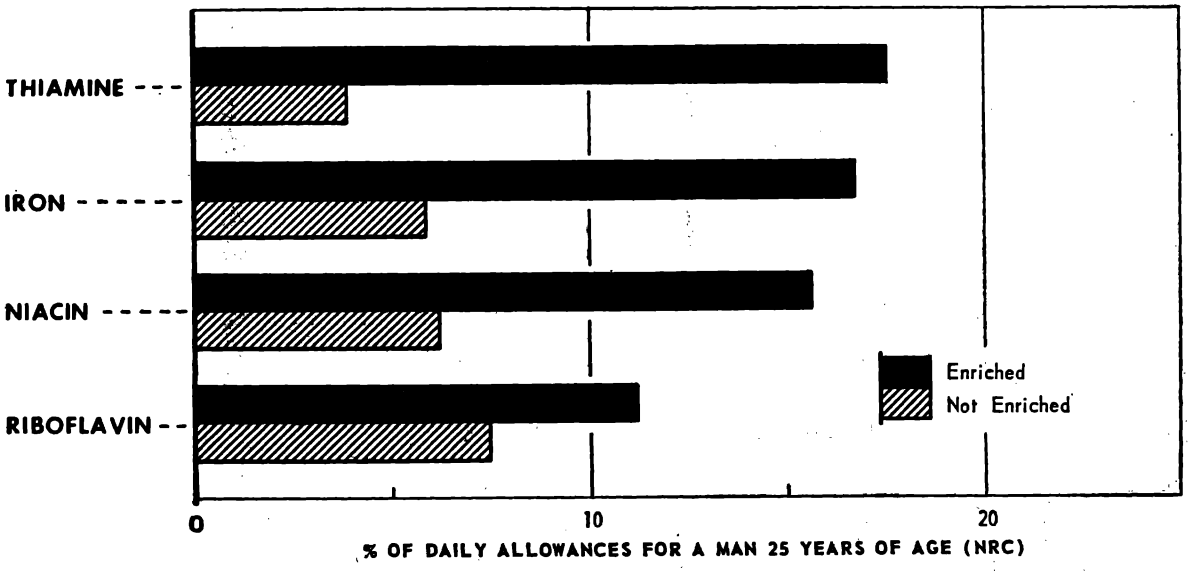
Annual income class (dollars)	Percent of total nutrient in diet added by enrichment with—			
	Thiamine	Riboflavin	Niacin	Iron
All income classes.....	16	3	13	12
1,000–2,000.....	20	5	15	14
5,000–7,500.....	13	2	9	10

Source: Changes in the Bread You Buy (*15*)

Chart 4

NUTRITIONAL CONTRIBUTION

Of One-fourth Pound * Enriched and Unenriched Bread



*Approximately 5 slices of bread ½ inch thick weighing 23 grams each.

Source: Consumption of Food . . . Raw, Processed, Prepared (*11*).
Recommended Dietary Allowances, 1953 (*20*).

Production

Ingredients used

Flour

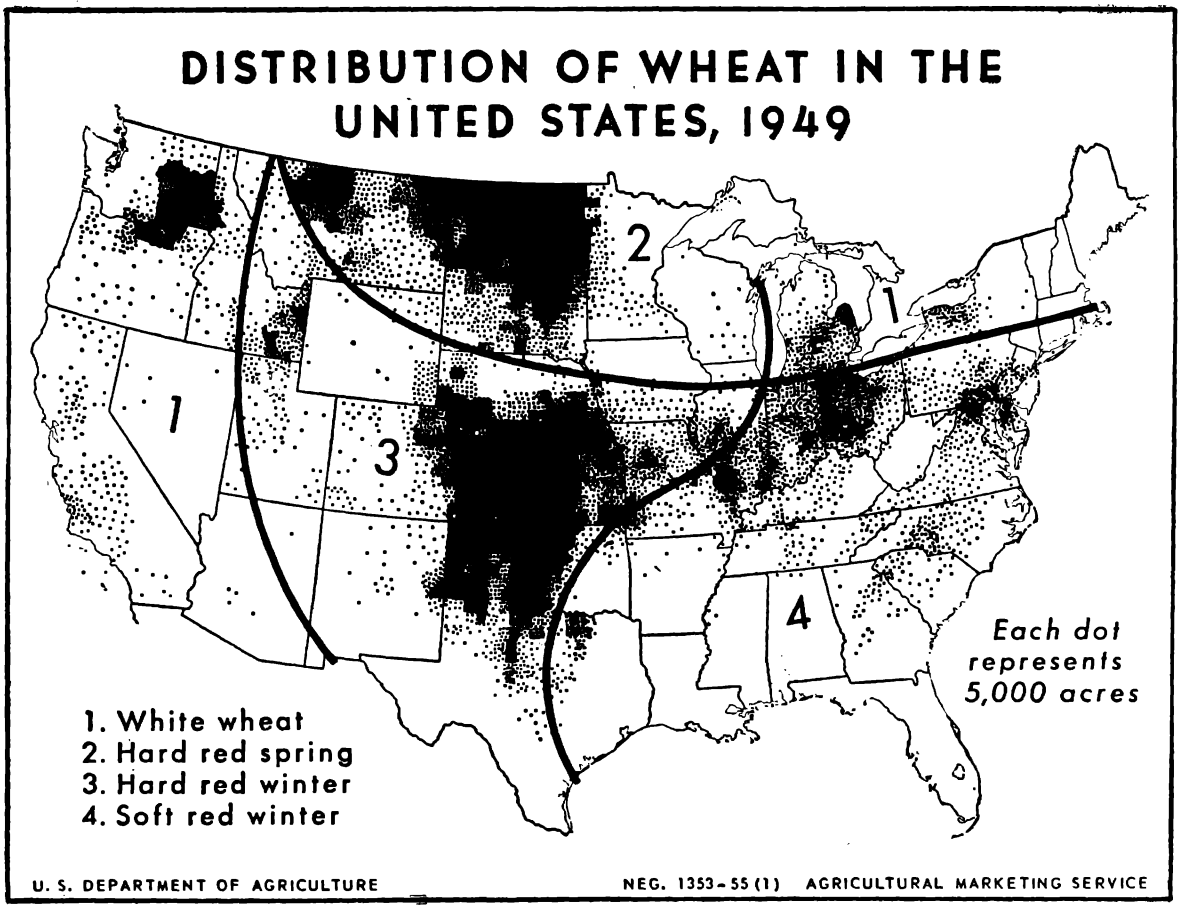
Wheat flour is the principal ingredient in bread. Wheat is the only grain which contains proteins adequate in amount and of a quality that produces an elastic dough which retains the gas produced during fermentation. For this reason, some wheat flour is added when other flours or finely ground meals, such as corn or rye, are used to make yeast-raised bread.

Characteristics of good bread flour are a high percentage of protein of the type which, when liquid is added, forms a strong, elastic gluten with good gas-retaining properties; adequate enzyme activity to produce sugar from the starch to support yeast during the fermentation period; and ability to absorb sufficient quantities of water to give a satisfactory dough. Bread flour for commercial baking must have gluten strong enough to withstand machine manipulation and still produce a dough that can retain fermentation gas. Bakers speak of flours with good baking quality as "strong" flours. In commercial bakeries, small-scale bread-baking tests are first made of the flour to determine the proper method for producing a satisfactory loaf of bread.

Hard red spring, hard red winter, and hard white wheats, individually or blended, are milled into flour for bread.

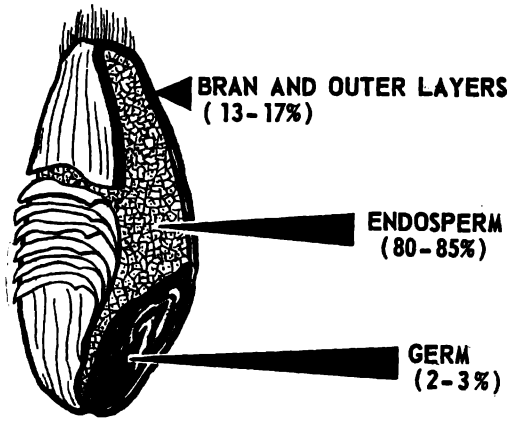
The four great wheat-producing areas in the United States are shown in chart 5. Hard red winter wheat is grown principally in the southern Great Plains (area 3), hard red spring wheat in the northern Great Plains (area 2), white wheat in the Northwest (area 1), and soft red winter wheat in the North Central States (area 4). The hard wheats are especially suited for making bread flours. Soft red winter wheat

Chart 5



produces flour suitable for biscuits, pastry, and cakes. Leading milling centers are located in Buffalo, N. Y., Kansas City, Mo., and Minneapolis, Minn.; other important centers are in Portland, Oreg., St. Louis, Mo., Salina and Wichita, Kans., Seattle and Tacoma, Wash., and Toledo, Ohio.

In the milling of wheat, the aim is to separate the bran and outer layers and the germ as completely as possible from the endosperm and to pulverize the endosperm into flour. Parts of a wheat kernel are shown below.



In the modern process of milling, wheat is passed through a series of grinding operations and the ground product is bolted (sifted). The grains of wheat are broken successively into smaller and smaller particles by sets of smooth and corrugated steel rollers, each set being closer together than the preceding pair. The rollers operating in pairs run at different speeds, so that the wheat kernel is torn apart rather than ground into a meal. The bran coats and wheat germ do not pulverize readily, but remain in flakes which can be sifted (bolted) from the more crumbly, brittle endosperm, as the crushed wheat passes through the rollers.

As each grinding operation takes place, the resulting particles are bolted, or sifted, and are directed through an elaborate system of spouts according to size. They are called streams by the miller. These streams are eventually all brought together again according to size. They differ in appearance, chemical composition, and baking properties, depending on the particle size and the varying amounts of the different parts of the wheat kernel they contain.

Many combinations of flour streams are possible to produce flours that differ in color, ash content, protein content, dough-handling properties, and bread characteristics, such as loaf volume, loaf shape, and crumb texture and color.

Patent flour is made by combining the more refined flour streams containing the least amount of bran and germ; it is high in protein content and is preferred by commercial bread bakers. *Clear* flour is a combination of the streams remaining after the patent flour has been removed; clear flours are high in protein and also in ash which darkens the flour, so that it is rarely used in the production of white bread. Clear flour is used in mixtures with rye or whole wheat flour. *Straight* flour is a combination of all flour streams suitable for producing white flour. Other blends of flour streams containing much higher percentages of the outer layers of the kernel are called *second clear* and *low-grade* (*red dog*) flour. The remainder of the wheat kernel is found in the byproducts, such as bran and shorts, which are used as animal feeds. In many mills a small part of the germ or embryo is separated in fairly pure form.

Whole wheat flour (*graham flour, entire wheat flour*) is made up of all parts of the wheat grain. Except for moisture content, the constituents are in the same proportions as in wheat grain from which it is milled.

Bread flours for commercial use are generally blends of two or more varieties of hard wheat; for home baking they are generally blends of soft and hard wheats.

Freshly milled flour requires "maturing" either by storage or chemical treatment in order to develop good baking quality. Oxidizing agents are ordinarily used to bleach and mature flour. This treatment changes the natural creamy color of the endosperm to white and develops good baking quality in the flour. If so treated, the label on the flour must bear the word "bleached." Kinds and amounts of chemicals that may be used for bleaching and maturing flour are specified in the Federal Food and Drug Standards (*22*).

Other Ingedients

Liquid in proper quantity is important in the development of the gluten. Poor volume may result from too much or too little liquid. When too much liquid is used, a weak gluten

esults which is i ncapable of holding sufficient gas; with too little liquid, the gluten is too strong to stretch sufficiently.

The keeping quality of the bread is indirectly affected by the amount of liquid used. After equal storage periods, bread of higher moisture content was judged to be significantly fresher than bread of lower moisture content (*23*).

The liquid used is water or milk or milk product, or a combination of them. Federal bread standards permit the use of water, milk (fluid, concentrated, condensed, evaporated, or dried), buttermilk or whey, or any combination of water and milk or milk product. The most commonly used forms of milk are nonfat dry milk solids (with water) and sweetened condensed milk.

In addition to contributing food value and flavor, milk solids make possible the use of more water in the dough, thus producing a loaf of higher moisture which will keep longer.

Yeast provides enzymes which ferment sugars to produce carbon dioxide that "lighten" the bread. Compressed yeast, and to some extent, dried yeast of a special type are used. According to Federal standards, two parts or less of the inactive dried yeast per 100 parts of flour by weight may be used (*4*); the proportion of compressed yeast is usually 2 to 2½ parts per 100 parts of flour.

Salt improves the flavor of the bread and has a strengthening effect on the gluten. It also has a stabilizing effect on fermentation by controlling the development of the yeast and the production of gas and other fermentation byproducts.

Optional ingredients in bread include sugar; shortening (fat); emulsifying agents; eggs; yeast foods, bread improvers, and dough conditioners; mold and rope inhibitors; other flour and grain products; enzyme preparations; and spice.

Although sugar from various sources is generally used for flavor, it provides additional material from which yeast produces carbon dioxide gas. The kind and amount of sugar affect the rate of fermentation. Sugar also helps to produce a brown crust on bread. Granulated sugar, brown sugar, dextrose, honey, corn sirup, and molasses (except blackstrap) may be used (*4*).

Shortening makes bread softer and more palatable; the crumb and crust are made more tender, and the volume is increased. Shortenings containing emulsifying agents are commonly used in bread. The emulsifying agent improves the tenderizing action of the shortening. Federal standards permit the use, as emulsifiers, of small amounts of lecithin and monoglycerides and diglycerides made from natural fats and oils (*4*). Large quantities are prohibited because they make bread appear fresh when it isn't and this practice is considered an attempt to deceive the consumer.

Eggs are used in some special types of bread. They increase the nutritive value, contribute flavor, color, and richness, and tend to give the product a fine-grained texture. Suggested quantities of egg solids for these special types of bread are 2 to 5 parts per 100 pounds of flour.

Yeast foods, dough conditioners, and bread improvers are commonly added to bread doughs. Calcium and ammonium salts stimulate the growth of yeast during dough fermentation. Other salts, which act as oxidizing agents, increase bread volume by aiding the development of the gluten and making the dough more pliable and better able to retain gas. Kinds and amounts of these substances permissible to add to bread are specified in the Federal standards (*4*).

Malt preparations and purified enzyme products are also permitted (*4*). They are frequently used to improve the baking properties of doughs made with flours that are deficient in natural enzymes.

Mold inhibitors are added to some breads. Federal standards specify vinegar, lactic acid, monocalcium phosphate, sodium propionate, calcium propionate, and sodium diacetate (*4*). Baking temperatures destroy most organisms in bread, but in the cooling and slicing processes contamination is possible from molds normally present in the air. If a mold inhibitor is used in bread subject to Federal regulation, that fact, with the name of the substance must be stated on the label.

Other flour and grain products are sometimes used with wheat flour in bread for variety or in times of wheat flour scarcity. Some of the products permitted in the Federal regulations include corn flour, potato flour, soy flour, and other specified flours and starches. Not more than three parts of these products to each 100 parts of wheat flour may be used if the bread is labeled "white bread." Breads not standardized may contain more of these products,

but they must be listed among the other ingredients on the label.

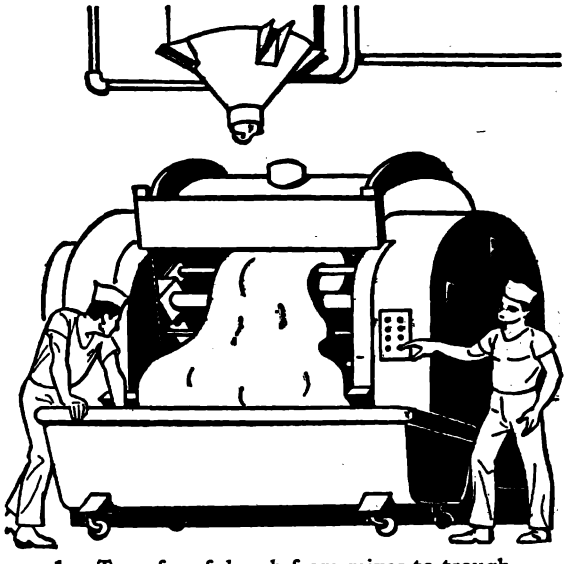
Spice, if stated on the label, may be an ingredient of bread.

How bread is made

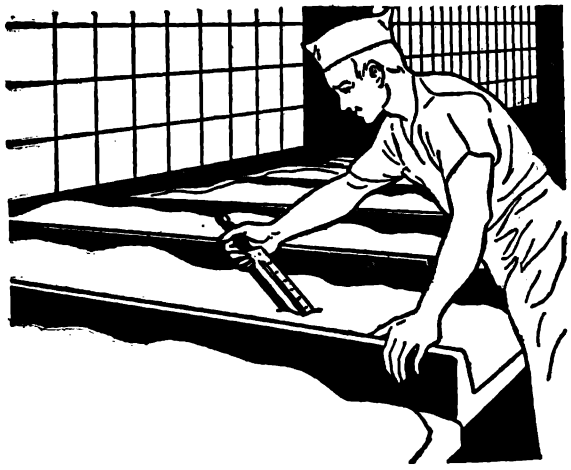
In the production of bread, ingredients are weighed or measured and combined in a mixer, with time and temperature controlled to produce a uniform, well-blended mix. After mixing, the dough undergoes fermentation.

There are two methods for making yeast breads—the straight dough method and the sponge and dough method. In the straight dough method all the necessary ingredients are added and mixed at one time. In the sponge and dough process, which is used by most commercial bakers, all of the yeast, yeast food, the enrichment wafers (if enriched flour is not used), malt, part of the flour, and part of the water are mixed into a sponge which is allowed to rise. The sponge is then remixed with the remaining water and flour and the other ingredients such as salt, nonfat milk solids, sugar, and shortening, to form a dough, and there is a second period of fermentation.

During fermentation, the dough or sponge must be kept at a temperature of approximately 80° F. and a relative humidity of 75 percent. A crust is prevented from forming by circulating humidified air over the dough or by covering the troughs containing the dough or sponge. See illustrations 1 and 2.



1. Transfer of dough from mixer to trough.



2. Taking the temperature of the fermenting dough in troughs.

In the fermentation process, carbon dioxide gas is produced in the dough by the action of yeast enzymes on sugar. Although it is usually an added ingredient of the dough, sugar is also provided by the conversion of starch to sugar through the action of enzymes in the wheat flour.

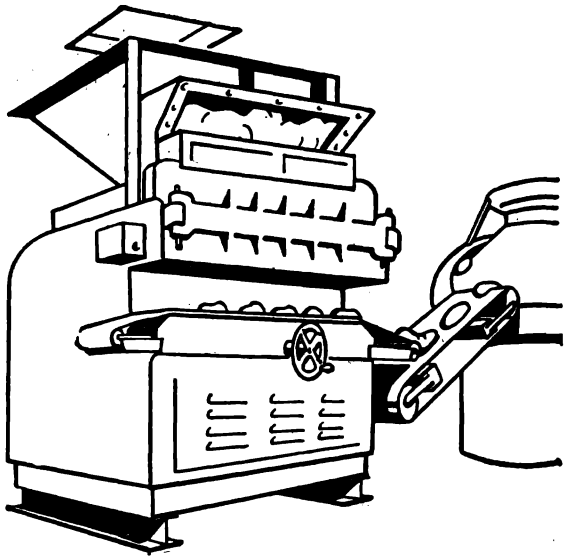
After fermentation, the dough is divided into portions and rounded so that a smooth skin is formed over the surface. This skin makes possible the retention of gas in the dough during subsequent fermentation.

The dough undergoes a short resting or recovery period (intermediate proofing) and is then molded, compressing some of the gas. The manipulation of the dough aids the development of the gluten so that it becomes elastic, forming a network around the starch particles and holding the carbon dioxide formed by the yeast.

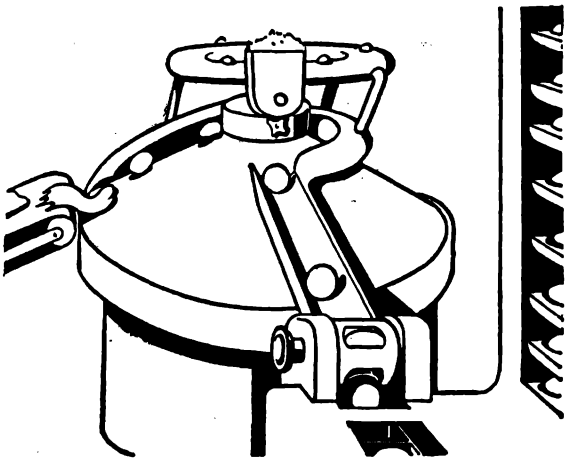
The dough is formed into loaves, placed in baking pans, and allowed to rise (proof). See illustrations 3, 4, 5, and 6.

Bread is proofed in a proof box with controlled temperature and humidity. During proofing, fermentation continues at a vigorous rate in the dough. The bread is allowed to rise approximately to the top of the pans. After proofing, the bread is baked. See illustrations 7 and 8.

During the first few minutes of baking, the dough expands considerably, owing to the rapid production and expansion of carbon dioxide in the dough. Steam is provided in the oven during this period to produce a glaze on the

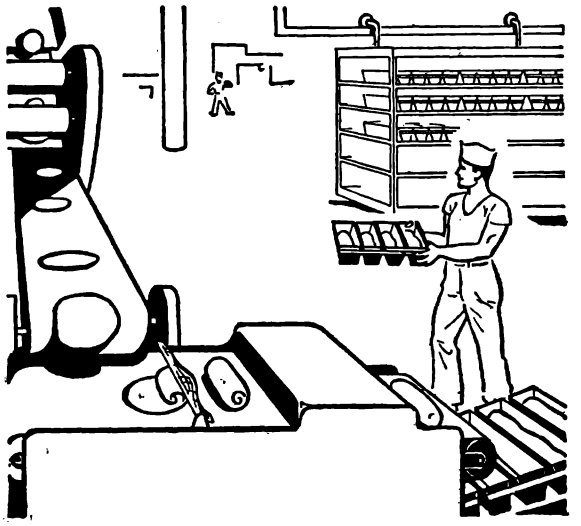


3. The divider measures out loaf-size portions of dough.

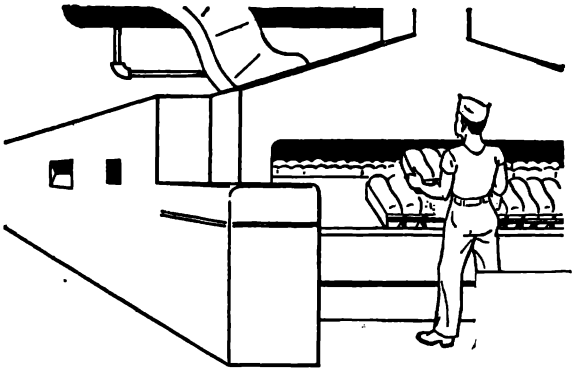


4. The rounder shapes the portions of dough.

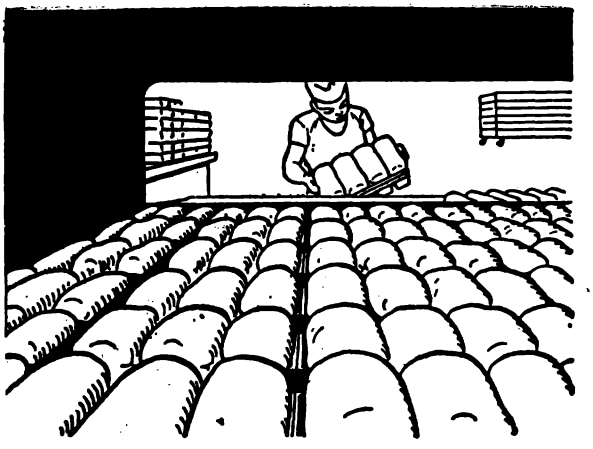
5. The dough "recovers" in the overhead proofer.



6. The molder kneads the dough.



7. Traveling belts carry the bread through the oven.



8. Bread is baked in huge ovens, hundreds of loaves at one time.

bread. When the temperature of the dough reaches 140° to 150° F., the enzymes are inactivated and gas production ceases.

During baking, the dough loses some of its moisture as well as the alcohol that was produced by fermentation, the gluten and other proteins are coagulated, and the starch is partially gelatinized. The outside of the dough becomes hot enough to produce dextrins on the surface, which are caramelized and result in the golden brown color of the crust.

After baking, the bread is cooled, usually sliced, and wrapped. See illustration 9.

Buying bread

The bread dollar

Bread is a bargain in nutrition. For the money spent, bread offers significant returns in many important nutrients. For this reason, low- and moderate-cost food plans suggested by the United States Department of Agriculture (*25*) include bread (enriched or whole grain) at every meal. Nutrients provided by 5 cents' worth of enriched bread are shown in chart 6.

In 1954, $1 bought six 1-pound loaves of white bread compared with 13 loaves in 1934. Although the price of bread doubled in this 20-year period (see chart 7), the nutritive return per loaf of bread purchased also increased. Five slices of bread in 1954 cost about twice as much as in 1934 but contributed over four times as much thiamine, three times as much riboflavin, and about twice as much calcium, iron, and niacin.

The 1954 retail price for bread was distributed over the various marketing operations as shown in chart 8.

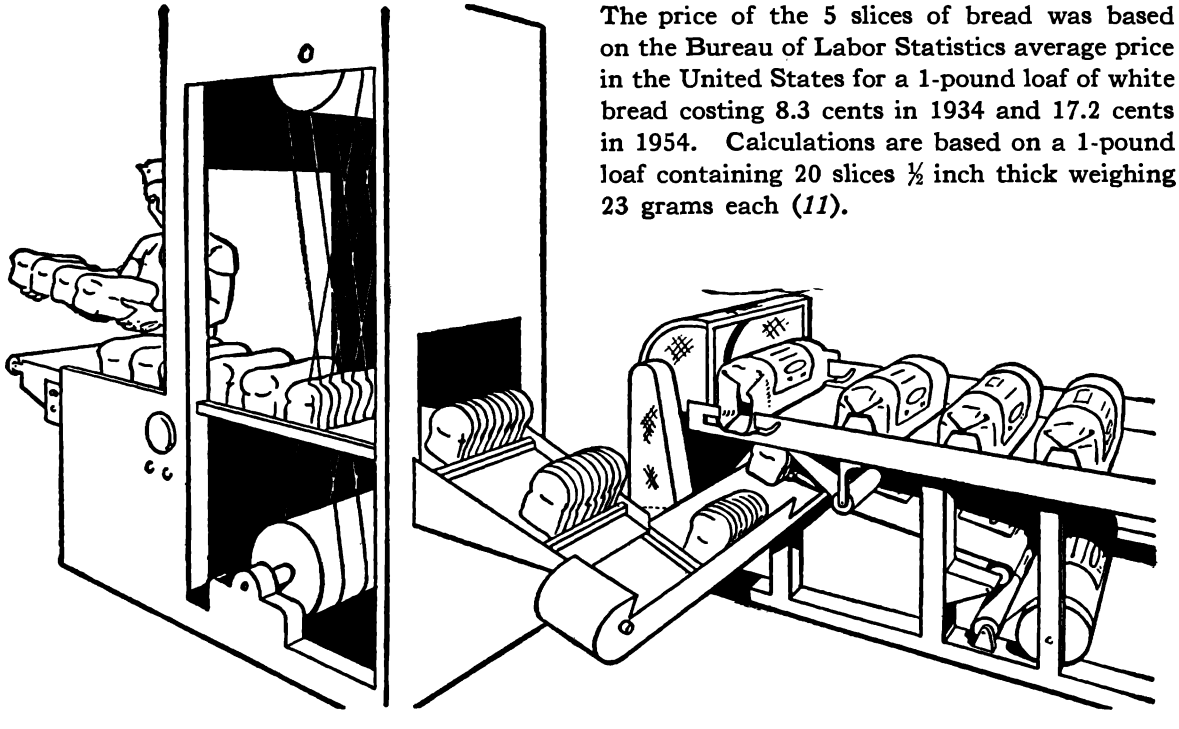
The costs and amounts of specified nutrients for five slices of bread in 1954 and 1934 were as follows:

	1954 [1]	1934
Costs of five slices of bread.....cents..	4.3	2.1
Thiamine.....milligrams..	0.28	0.06
Riboflavin.....do....	.18	.05
Calcium.....do....	90	43
Iron.....do....	2.0	.8
Niacin.....do....	2.5	[2] 1.0

[1] Enriched.
[2] Estimated value.

Source: Composition of Foods (*11*) and unpublished data of the Household Economics Research Branch.

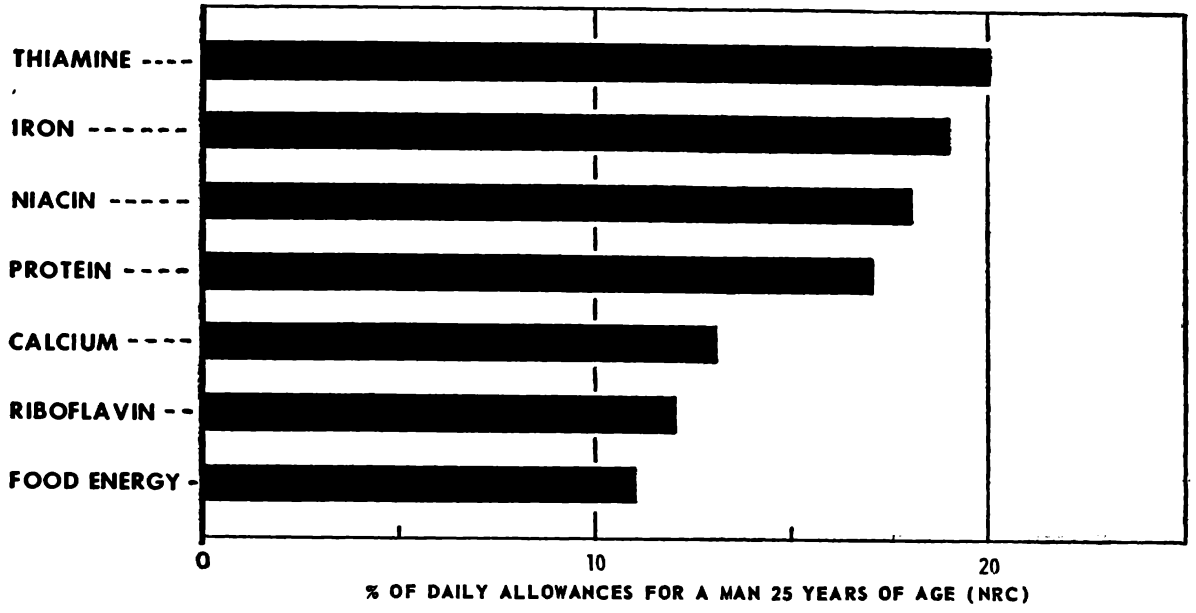
The price of the 5 slices of bread was based on the Bureau of Labor Statistics average price in the United States for a 1-pound loaf of white bread costing 8.3 cents in 1934 and 17.2 cents in 1954. Calculations are based on a 1-pound loaf containing 20 slices ½ inch thick weighing 23 grams each (*11*).



9. The cooled bread is sliced by sharp blades. The sliced bread is tightly sealed in sanitary wrapping.

Chart 6

NUTRITIONAL CONTRIBUTION OF 5¢ WORTH OF BREAD *



*Enriched. Approximately 6 slices of bread ½ inch thick weighing 23 grams each. Based on the 1954 Bureau of Labor Statistics average price for the United States, 17.2 cents per pound loaf.

Source: Consumption of Food . . . Raw, Processed, Prepared (*11*).
Recommended Dietary Allowances, 1953 (*20*).
Retail Food Prices by Cities, Bureau of Labor Statistics, 1954.

A study of the food consumption of urban families in 1948 shows that bread is a good buy. These families spent 4 percent of their total food budget for bread and received from it 14 percent of the total thiamine in their diets, 13 percent of the niacin, 12 percent of the iron, 10 percent of the protein, riboflavin, and food energy, and 9 percent of the calcium. (See chart 9.)

The bread dollar can be stretched by economical practices. Waste can be avoided by storing bread properly. Half-loaf sizes are available in some markets for those who use small quantities. Day-old bread is frequently sold at a discount, and is especially suitable for toast, stuffings, and cooked dishes.

Selection

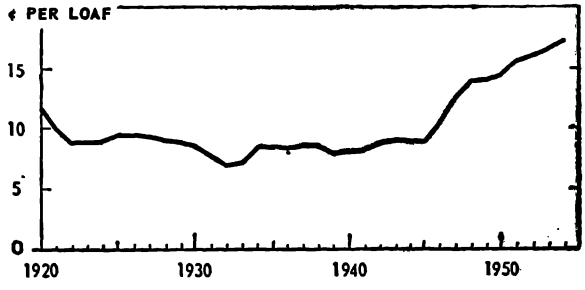
A good loaf of bread is symmetrical in shape, well-risen, and the crust is a rich, golden brown. The crumb of good bread is silky in appearance, of uniform cream color, and reasonably fine and even in grain. The combination of texture and grain makes the freshly cut surface of bread feel velvety or silky.

The characteristics that consumers rated highest, when asked about bread, were good flavor, freshness, and keeping quality.

Good flavor is dependent on the way the bread is made as well as on the ingredients used. Salt and yeast are important for flavor.

Chart 7

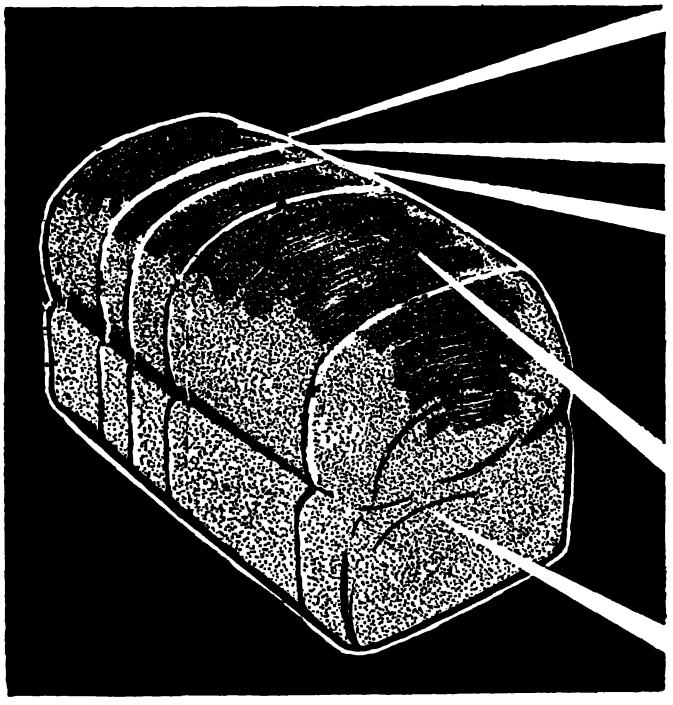
AVERAGE PRICE FOR WHITE BREAD



Source: Retail Food Prices by Cities, Bureau of Labor Statistics.

Chart 8

MARKETING COSTS FOR A LOAF OF BREAD, 1954



3.2¢ FARMERS
Production of:
Wheat----------2.7¢
Other ingredients--0.5¢

0.8¢ FLOUR MILLS
Milling of wheat----0.8¢

1.1¢ TRANSPORTATION AGENCIES, GRAIN ELEVATORS, PROCESSORS
Transportation, storage, processing of nonwheat ingredients, and handling of all ingredients, from farm to bakery -----1.1¢

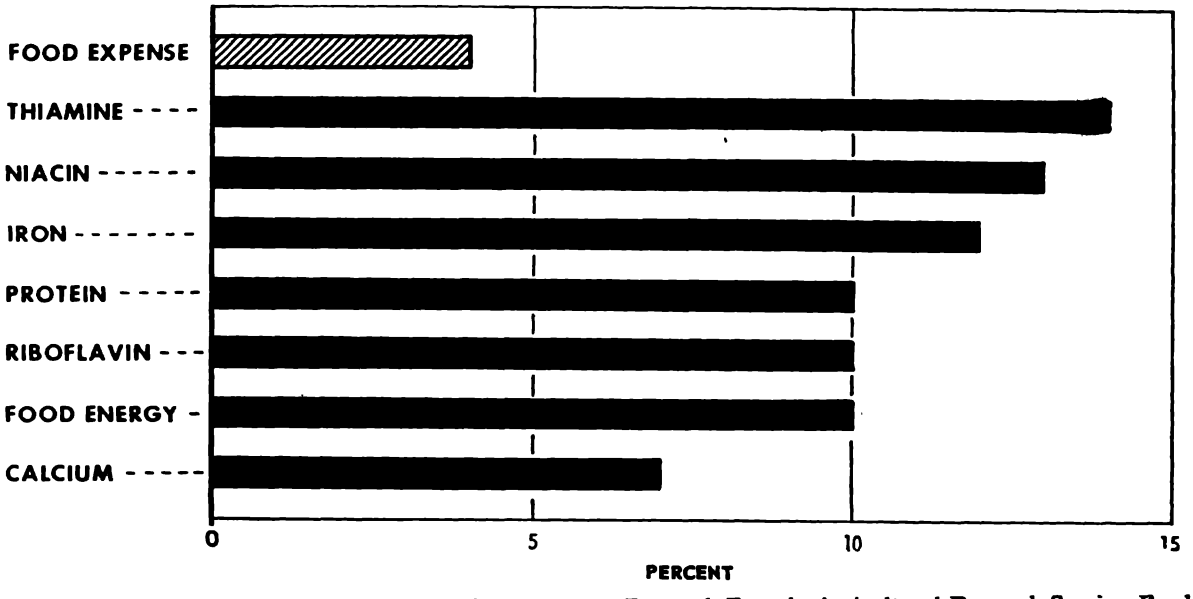
10.1¢ WHOLESALE BAKERIES
Production costs for labor and wrapping----- 5.5¢
Selling and administration---- 4.6¢

2.0¢ RETAIL GROCERS
Selling costs----- 2.0¢

*Retail price: 17.2 cents per pound loaf.
Source: Analysis of Price Spreads for Bread (*24*).
Price Spreads for White Bread (*26*). Marketing Margins for White Bread (27).

Chart 9

PERCENT OF FOOD DOLLAR SPENT FOR BREAD AND PERCENT OF NUTRIENTS CONTRIBUTED IN DIETS



Source: Unpublished data from Household Economics Research Branch, Agricultural Research Service, Food Consumption Surveys, 1948.

While the aroma of freshly baked bread is pleasing, it is not a reliable guide to the flavor. The bread nearest the crust has more flavor than that in the center of the loaf.

Different kinds of fresh bread vary in softness, so that squeezing bread is not a reliable test for freshness. Laboratory tests show discrepancies between softness, as measured in the laboratory, and freshness as determined by taste-testing (*28, 29*). To provide information on freshness some bakeries date their bread on the label.

There is a limited retail distribution of frozen bread, frozen unbaked rolls, and frozen bread dough. Freezing helps to keep baked bread fresh. The frozen dough can be thawed, shaped into bread or rolls, allowed to rise, and baked. The frozen unbaked rolls require a short rising period, before baking.

Available also are partially baked bread and rolls and packaged roll mixes. The partially baked products are baked a short time to brown them, and can be served warm from the oven. The packaged roll mixes include measured quantities of all ingredients with directions for making and baking the rolls.

Use in family meals

Bread is a basic food in American family meals. Its bland flavor makes it suitable for combining with many other foods. The market offers a wide selection of breads and rolls, which can be served in a variety of ways—plain, toasted, warm from the oven, in sandwiches.

In planning meals, 1 to 2 slices of bread are ordinarily allowed per serving. A 1-pound loaf will provide 18 to 20 slices of bread about ½ inch thick.

Sandwiches may be hearty or dainty, served plain or toasted. They may be single, double- or triple-decked, or stacked high with a variety of fillings. Sandwiches go into lunchboxes and on picnics . . . are equally suitable for parties. They're popular in the school lunchroom . . . and on the family table. Hearty meat sandwiches may be served hot, with gravy. Sweet sandwiches may take the place of dessert. A 2-pound loaf of sandwich bread will provide 28 slices ½ inch thick or 36 slices ⅜ inch thick with end crusts.

Frozen slices of bread, when exposed to room temperature, thaw in a short time. They toast satisfactorily without previous thawing, but require a slightly longer time.

Frozen slices of bread are easier to spread for sandwiches than soft, crumbly bread. When tightly wrapped and carried in a lunch, they help to keep other foods in the lunchbox cold. In a few hours, they are thawed and have the characteristics of fresh bread.

Frozen loaves of bread require 3 to 4 hours at room temperature for thawing.

Bread that has lost its freshness may be toasted . . . dipped in beaten egg and fried for French toast . . . cut thin and toasted slowly in the oven until crisp for Melba toast. It may be cubed for puddings, fondues, stuffings, and for thickening vegetables . . . cubed and toasted (croutons) for serving with soups. It may be made into crumbs for puddings and for baked-dish toppings.

One ⅝-inch slice of fresh white bread will yield approximately 1 cup of soft bread crumbs made by tearing the bread into small pieces. If cut into cubes, one such slice will yield about 1 cup of soft bread cubes, or about ¾ cup of toasted bread cubes, if toasted slowly in the oven until brown.

One ⅝-inch slice of dry white bread run through a food chopper using a fine blade will yield approximately ¼ cup of dry bread crumbs. Cut into cubes, it will yield about ¾ cup. Bread crumbs are often buttered for topping baked dishes by heating, while stirring, in melted butter or margarine.

Keeping quality of bread

As bread ages, it loses its palatability, which may be due to any of three causes—loss of moisture, molding, and staling.

The commercial wrapping of bread in good-quality waxed paper or in cellophane is effective in preventing loss of moisture.

Mold spores are commonly present in the air, so that bakeries take precautions to prevent contamination of the bread. Rapid cooling and immediate wrapping minimize the opportunity for such contamination. Areas likely to be free of mold spores are used for cooling, slicing, and wrapping. Some bakeries cool bread in washed air or use ultraviolet lamps at slicing and wrapping machines.

True staling, characterized by firmness and loss of flavor, is independent of moisture loss

and mold growth. During the first 12 to 18 hours after baking, bread stales rapidly. The soft part of the starch (the gel) becomes more rigid. The crumb becomes dry and hard, the crust soft and leathery. Although staling is one of the major problems of both the consumer and the baking industry, its cause has not yet been fully determined (*28*).

Home care and storage

Bread should be stored in the original wrapper, and the wrapper should be closed tightly after each use. The best method to prevent staling is to store bread in the home freezer or in the freezing compartment of the home refrigerator. Frozen storage is practicable for meal-to-meal use, as well as for several weeks or longer. See information on using frozen bread in "Use in family meals," p. 18.

The next best place for storing bread is in a well-ventilated breadbox in a warm part of the kitchen. The best temperature is slightly above ordinary room temperature—between 70° and 90° F.

Bread is subject to mold in warm, humid weather, especially if stored in a container without good circulation of air. It can be kept from molding by storing at ordinary refrigeration temperature, but will develop a harsh crumb rapidly.

Breads with a crisp crust, like French bread, lose moisture rapidly and have a very short storage life. They should be stored unwrapped in a well-ventilated breadbox.

Bread made with milk retains moisture better and so keeps fresh longer than bread made with water (*18*).

Questions from homemakers

Question: For what nutrients is bread important?

Answer: Enriched bread and whole wheat bread make important contributions of iron and B-vitamins—thiamine, niacin, and riboflavin. Bread also provides considerable protein and energy, especially when eaten in average amounts or more.

Question: Is bread a good source of calcium in the diet?

Answer: The amount of calcium contributed to the diet by bread depends on the ingredients used in making the bread and on the amount of bread eaten. The calcium content of bread is increased when milk solids and other calcium-containing ingredients are used. In a recent study, the average calcium content of 400 samples of commercial bread analyzed was 334 milligrams per pound (see p. 7). Five slices of bread containing 334 milligrams of calcium per pound would supply about 80 milligrams of calcium or about one-tenth of the day's allowance (NRC) for calcium.

Question: What is meant by the statement on the bread label "calcium (or sodium) propionate added to retard spoilage"?

Answer: This means that a small amount of one of these harmless chemicals has been added to the bread to retard mold and bacterial spoilage.

Question: Why is flour bleached?

Answer: Flour is bleached to change its natural creamy color to white. At the same time, the flour is also matured which improves its baking quality. Most consumers seem to prefer the type of white bread made with bleached white flour. However, some bakeries are producing breads from unbleached flour as stated on the label.

Question: How can I tell if the bread is enriched?

Answer: If bread is enriched the label will state the fact as well as show the quantity or the percentage of the minimum daily requirement of enrichment each ingredient furnished per half-pound (or other quantity) of bread.

Question: When bread labels state the percentages of daily requirements of different nutrients provided by a given quantity of the bread, to what requirements do these percentages refer?

Answer: The daily requirements referred to on such labels are the minimum daily requirements promulgated by the Federal Food and Drug Administration. (See reference *5*.)

Question: What is the difference between whole wheat, entire wheat, and graham bread? Are they the same as "wheat" or "wheaten" bread?

Answer: Whole wheat, entire wheat, and graham bread are made with whole wheat flour as the sole flour constituent. Graham bread is ordinarily made with molasses for sweetening, which gives it a characteristic flavor. Wheat (wheaten) bread contains both white and whole wheat flour.

Question: What is salt-rising bread?

Answer: Salt-rising bread is leavened with a special bacterial ferment instead of yeast. It is fine-textured and close-grained, and has a distinctive cheese-like flavor and odor. The crumb may be white or cream-colored, depending on the ingredients. Salt-rising bread usually contains more shortening and sugar than other breads.

Question: Why is bread an important food in low-cost food plans?

Answer: Enriched or whole grain bread may well be included in every meal in well-planned low-cost diets. They are inexpensive and furnish many important nutrients, including low-cost protein.

Question: Is bread fattening? Should it be included in a reducing diet?

Answer: Bread is not a relatively high-calorie food. A slice of white bread one-half inch thick furnishes 63 calories; a slice of whole wheat bread, 55 calories. Some of the breads of high-protein content which are low in fat may furnish as little as 46 or 48 calories.

Many well-planned reducing diets include enriched bread or whole wheat bread because they provide important quantities of protein and of some B-vitamins and iron.

Question: In selecting bread, how can I tell if it is fresh?

Answer: Some companies indicate the freshness by dating their bread. Fresh bread is usually soft, but this is not a reliable test because some breads are firmer than others when freshly baked.

Question: How should I store bread at home to keep it fresh?

Answer: Keep bread in the original wrapper and close it tightly after each use. Store bread: (1) in the home freezer or in the freezing compartment of the home refrigerator; or (2) in a well-ventilated breadbox in a warm part of the kitchen. It keeps well in a breadbox for several days. Bread can be frozen for meal-to-meal use or for several weeks or longer. Ordinary refrigeration temperature keeps bread from molding in warm, humid weather, but it develops a harsh crumb more rapidly than at room temperature.

Question: How can I find out what laws my State has regarding bread, including enrichment laws?

Answer: The State departments of health or agriculture can provide information on bread laws in your State. The city in which you live may also have regulations on bread.

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A partial list of materials for use with consumer groups

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