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COMPARATIVE EVALUATION OF THE QUALITY AND ACCEPTABILITY OF CERTAIN COMMERCIAL WAFFLE MIXES

by

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TABLE OF CONTENTS

INTRODUCTION

Decisions of food purchase are primarily choices among alternatives. Today's consumer is confronted with food items available in three stages of preparation: "(a) food with a minimum amount of processing, requiring most of the preparation be done in the home; (b) partially prepared foods; and (c) ready-to-serve foods that involve no more than heating or serving" (Kolmer and Gartner, 1961). Selection from such alternatives is a complex process requiring consideration of available resources, acceptability, and nutritional value. Findings in a food consumption survey (USDA, 1965) revealed an increase in use of convenience foods. Bivens (1969) reported the percentage of the food dollar spent for convenience food items increased between 1955 and 1965.

The work reported herein is an extension of a larger study on the use of convenience foods by families in Kansas. Convenience foods in the study are defined as "foods which have had services added to the basic ingredients to reduce the amount of preparation required in the home" (Harp and Dunham, 1962). Among convenience foods reported used most frequently by respondents in the study were commercial waffle mixes. Harp and Dunham (1963) and Peterkin and Cromwell (1971) provided information regarding comparisons of cost and time economics for certain products made from commercial mixes and from individual ingredients. However, no data were found regarding objective measurements or sensory evaluations of packaged waffle products indicating need for further study.

The present study then was designed to determine any similarities or differences among waffle products made from commercial mixes used most

frequently by respondents in two surveys of Kansas households. The specific objectives were to: (a) evaluate the quality and acceptability of three waffle mixes by means of objective measurements and sensory evaluation, and (b) determine reasons, if possible, for use of a given brand of waffle mix.

EXPERIMENTAL

Ingredients

All ingredients, except fresh fluid milk, were obtained at one time from the same source and kept refrigerated until used. Homogenized milk was obtained from a common source each time waffles were prepared.

Preparation

Preliminary work was performed to standardize the weight of basic ingredients to provide approximately 2-1/2 c. batter, and to standardize mixing time for each treatment.

Prior to each preparation period, eggs for all products were mixed by blending 30 seconds at speed 2 until homogenous. Then ingredients for each product were weighed on a torsion balance, placed into containers and sealed. Ingredients were pre-measured and incubated in a Labline incubator, at a temperature ranging between 19 and 24°C., to facilitate preparation and evaluation during time periods available for work.

The method of preparation followed for each of 3 mixes was that suggested by the manufacturer (Table 6, Appendix). Each product was mixed separately and a waffle baked from one cup of batter. A second cup of batter was measured for another waffle, covered with a plastic wrap, and held until the first waffle from each mix had been baked. A Sunbeam

Radiant Control Waffle Baker, Model CG-1, was used for baking and was preheated to setting 4, of a 5-setting thermostatic control selection.

Evaluation of Batter and Baked Waffles

Quality and acceptability of waffles were evaluated by means of objective and sensory measurements. Immediately after baking waffles were placed on wire cooling racks and cooled to room temperature before evaluating. Sections of waffle for each objective evaluation and for scoring by the panel were chosen according to a randomized design (Fig. 2 and Form 1, Appendix).

Specific gravity. Specific gravity of batter for each product was determined, to compare the lightness of each. Calculation was made by dividing the weight of a specific amount of batter at a given temperature by the volume of the container used at that temperature.

Linespread. Viscosity of batters was calculated on the basis of linespread, as specified by Griswold (1962), except the batter was allowed to spread only 10 seconds. Four readings were taken immediately and the average calculated. Linespread figures represent the number of 1/8 inch units the batter spread in 10 seconds.

Volume. Volume of a 4.5 inch-square-section of waffle of each brand was measured by seed displacement as an index to volume (Griswold, 1962).

Compressibility. Compressibility of waffles was measured using a Precision penetrometer with a weighted disc. A flat disc weighted by 100 g. was used. The distance the disc depressed the waffle in 1 section,

at 2 designated points, was recorded in millimeters and the average calculated.

Breaking strength. Breaking strength of each waffle was measured with the use of a 1,000 g. capacity shortometer (Fogg, 1971). Waffle strips were cut to measure 2.5 x 5.5 cm. Approximately 1-1/2 hr. after baking, breaking strength was measured on duplicate samples of each product and the average recorded.

Moisture content. Percentage moisture content of the waffles was determined in a C. W. Brabender semi-automatic rapid moisture tester (model SAS). One section of waffle from each variation was chopped and blended in an 8-speed Osterizer blender, and duplicate 5 g. samples of each were dried 40 minutes at 120° C. Readings for the samples were averaged and considered as moisture content.

Color. Color differences, including reflectance, redness, and yellowness of waffles were determined using a Gardner Automatic Color Difference meter (model AC-2A, series 200). The instrument was standardized prior to use with a ceramic tile with calculated values of: Rd (reflectance) 37.6; a+ (redness) 6.2; and b+ (yellowness) 15.0. A 5 g. portion of the chopped waffle section was weighed and packed into sample cups. The cup was placed over the aperture of the instrument so that the center of the cup was directly over and covering the opening. An initial set of readings was taken, then the sample cup was rotated 90° in a clockwise direction and another set taken. The average of these readings was considered to be the color value.

Sensory evaluation. Sensory evaluation of the quality and acceptability of waffles was made by an 8-member panel. All products were at room temperature when scored. For evaluation of external appearance, waffles were placed on a white background beneath a Macbeth skylight simulating daylight. A score card (Form 2, Appendix) was used to record evaluations. The frequency of use of selected descriptive terms appearing on the score card was calculated (Table 7, Appendix) but not subjected to statistical analysis. The panel also ranked waffle samples according to preference and indicated whether or not they considered a product to be acceptable to serve at a meal.

Statistical Design and Analysis of Data

Three brands of commercial waffle mix were used: A (Aunt Jemima), B (Bisquick), and C (Hungry Jack). The randomized complete block design (Form 3, Appendix) with 8 replications for each product was used in preparing and presenting waffles for evaluation.

Data from measurements used in evaluation were subjected to the following analysis of variance:

Source of Variation	D/F
Treatment	2
Replication	7
Remainder	14
Total	23

Least significant differences (LSD, $P < 0.05$) were calculated if F values were significant.

RESULTS AND DISCUSSION

Treatment means, F-values, and least significant differences for objective and sensory measurements of waffles appear in Tables 1 and 2, respectively. Throughout the discussion A, B, and C refer to the commercial mixes evaluated, A (Aunt Jemima), B (Bisquick), and C (Hungry Jack).

Objective Evaluation

Specific gravity. Between batters very highly significant differences ($P < 0.001$) were noted for specific gravity. Batter made using brand A had a significantly lower mean value for specific gravity than batters made from brands B and C. There was no significant difference between batters B and C. The low mean value for batter A was not unexpected as the total mixing time was greater than for the other products (Table 6, Appendix). Therefore, more air might have been incorporated in batter A resulting in a lower specific gravity.

The proportion (%) of ingredients used in each formula and the method of preparation, including mixing time, were most comparable for products A and B; however, the greatest differences in specific gravity were noted between these batters (Table 1). Action of the leavening incorporated into the mix was a possible factor for the differences. However, the type and amount of leavening were not revealed by the manufacturer and evaluation of this factor was not possible.

Linespread. Differences in linespread of batters were very highly significant ($P < 0.001$). Significance was noted between batters A and C, and between B and C. The differences were attributed to characteristic

Table 1 - Treatment means, F-values, and LSD's attributable to objective measurements of waffles

Measurements	Brands Measured A	B	C	F-value	LSD[a]
Batter					
Specific gravity	0.9335	1.0403	1.0387	42.16***	0.028
Linespread	8.7	9.4	5.5	43.01***	0.934
Baked waffle					
Volume (cc)	180.0	190.0	191.3	4.60*	8.454
Compressibility (g)	1.6	2.2	1.3	0.46ns	--
Breaking strength (g)	311.4	494.4	577.5	7.22***	149.007
Moisture	14.2	11.6	10.1	10.90***	1.875
Color: Rd	13.2	15.7	21.0	45.73***	1.736
Color: a+	6.9	6.7	5.8	5.89**	0.709
Color: b+	17.1	16.6	20.2	41.53***	0.890

[ns] Not significant

[*] Significant at 5% level

[**] Significant at 1% level

[***] Significant at 0.1% level

[a] LSD, least significant difference at 5% level

physical properties of the mixes, amount of liquid used in proportion to dry ingredients, and extent of mixing (Table 6, Appendix). Brand A packed readily and appeared like all-purpose flour; brand B was coarse, compact, and lumpy; whereas, brand C appeared more like cake flour. Batter made from brand B using the greatest proportion of liquid to dry ingredients and an intermediate mixing time was least viscous. Batter C using the intermediate proportion of liquid to dry ingredients and shortest mixing time was most viscous.

Volume. Waffles made using brand C had the greatest mean volume of the products evaluated; those made from brand A had the lowest (Table 1). Significant difference in volume was evidenced by the mean treatment values between A and B, and A and C. Differences in waffle volume between brands may have resulted from the amount and type of leavening incorporated into the mix.

Compressibility. Differences between brands did not affect tenderness of the baked waffles as measured by compressibility. Mean compressibility values were not significantly different.

Breaking strength. Mean values for breaking strength differed significantly between waffles made from brands A and B, and A and C. No significance was noted between products made using brands B and C. Waffles made from brand A broke most easily and were considered most tender; those made from brand C were least tender.

High specific gravity and low viscosity values, as noted for batter C, are indications of a compact finished product requiring greater effort to break. Values for mean breaking strength showed a relationship to

volume. Waffles made using brand C had the greatest volume and mean value for breaking strength; whereas, products made from brand A had the lowest volume and lowest mean value for breaking strength.

Moisture content. Mean values for moisture content were very highly significant ($P < 0.001$). Waffles made from brand A were significantly more moist than either products from brands B or C. The mean values determined for percentage moisture content seemed to relate to proportions of ingredients used for each product (Table 6, Appendix).

Color. Very highly significant differences ($P < 0.001$, Table 1) in color reflectance (Rd) and in yellowness (b+) and highly significant differences ($P < 0.01$) in redness (a+) among waffles were attributed to the ingredient content of the mixes and the proportion of ingredients used in each formula (Tables 6 and 8, Appendix).

Differences in reflectance (Rd) were significant between waffles using brands A and C, A and B, and B and C (Table 1); the mean value was significantly higher for product C than for either of the other products evaluated. Waffles made using the brand A mix had the highest mean value and brand C waffles the lowest mean value for redness (a+).

Yellowness values (b+) differed significantly between products made from brands A and C, and brands B and C. Waffles made from brand C had the highest mean value for yellowness.

Sensory Evaluation

Sensory evaluation of waffles prepared from the three mixes revealed striking differences for many of the characteristics scored (Table 2). Mean scores for product C were consistently higher in all sensory

Table 2 - Treatment mean scores,[a] F-values, and LSD's attributable to sensory evaluation of waffles

Measurements	Waffles from brands A	B	C	F-value	LSD[b]
Shape	4.70	4.71	4.92	0.65^{ns}	--
Volume	4.81	5.00	5.16	5.01^{*}	0.230
External color	4.11	4.19	5.49	15.58^{***}	0.576
Grain	4.29	3.48	5.31	55.37^{***}	0.364
Internal color	4.53	3.51	5.65	52.42^{***}	0.434
Aroma	4.34	3.71	5.56	32.30^{***}	0.487
Texture	4.05	3.69	5.14	19.34^{***}	0.505
Flavor	3.51	3.10	5.55	98.03^{***}	0.390

[a] Range 7 to 1, with 7 as high

[b] LSD, least significant difference at 5% level

ns Not significant

* Significant at 5% level

*** Significant at 0.1% level

evaluations than for products A and B (Fig. 1). In general, waffles made using brand B were scored lowest by the panel. The mean scores of product B for five of the seven characteristics measured were below 4.0, which was considered as standard for purposes of scoring. Differences in grain, internal color, aroma, and flavor between any two products were very highly significant ($P < 0.001$, Table 2). Differences in external color and texture between products A and C, and B and C were very highly significant. Significant differences ($P < 0.05$) in volume were noted only between products made from brands A and C. Mean scores for shape were not significant.

Aroma and flavor. Scores for aroma and flavor revealed substantial differences between brands, C having the highest mean score for both characteristics (Fig. 1). Brand B was scored lowest. The aroma of products A and B was said to be strong, and the flavor to be strong and bitter (Table 7, Appendix). Waffles made using brand C were described as having delicate aroma and delicate and sweet flavor.

Variations in aroma and particularly flavor may be attributed to the ingredient content of the mixes (Table 8, Appendix). Possibly any undesirable aroma and flavor are masked when waffles are consumed with butter or margarine and flavored toppings.

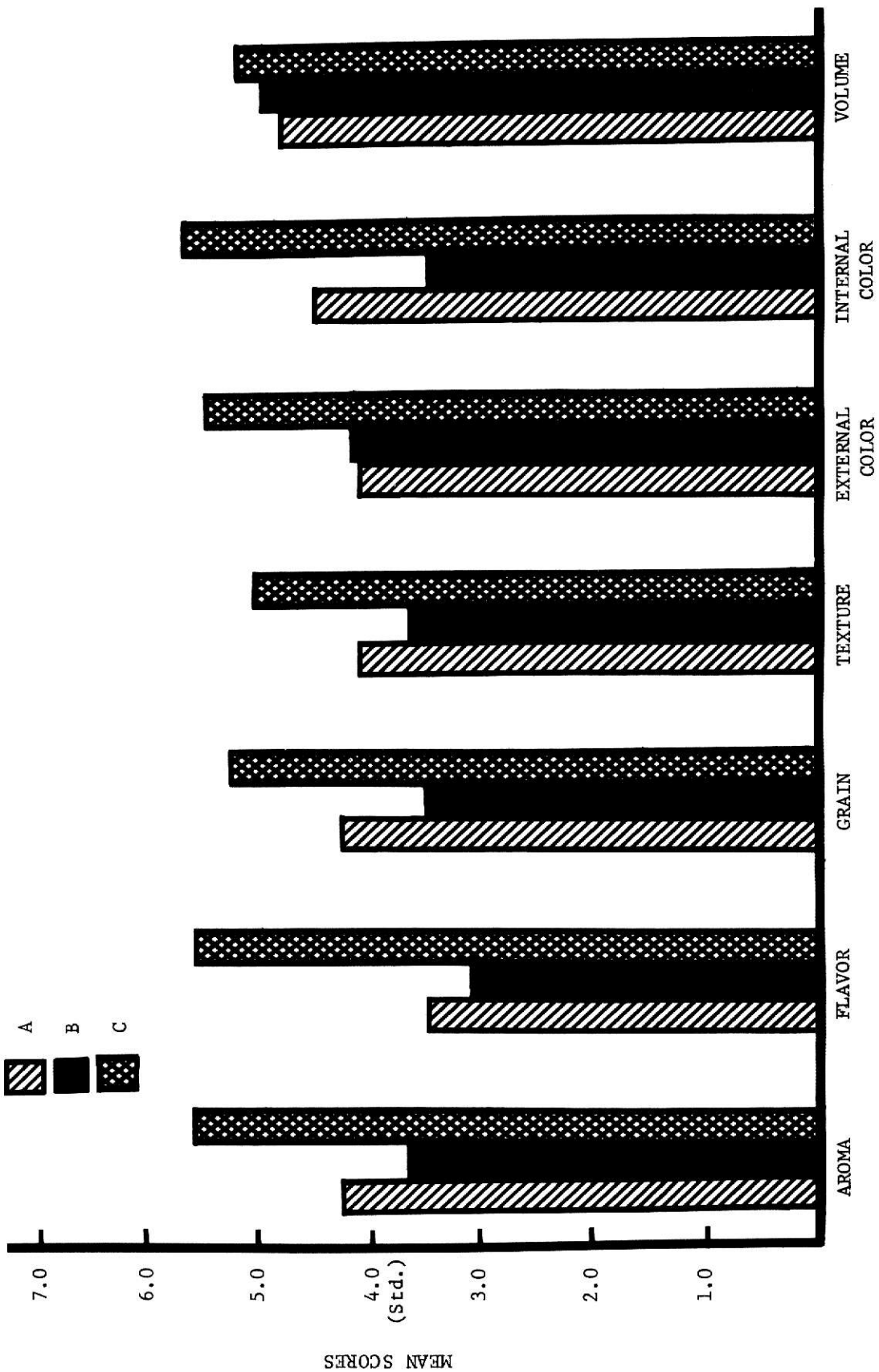
Grain. Grain was scored most desirable in products made using brand C, and least desirable for those using brand B (Fig. 1). Contrasting descriptions were given for the grain of waffle products (Table 7, Appendix). Medium was the term used most often for product A, and medium or fine for product C, whereas coarse was the adjective used to describe

Fig. 1 - Mean scores for sensory evaluation of waffle brands.

A - Aunt Jemima

B - Bisquick

C - Hungry Jack


MEAN SCORES
7.0
6.0
5.0
4.0
(Std.)
3.0
2.0
1.0
A
B
C
AROMA
FLAVOR
GRAIN
TEXTURE
EXTERNAL COLOR
INTERNAL COLOR
VOLUME

product B. A comparison of panel scores and adjectives selected for each product indicated that a desirable grain for waffles was fine or medium. Panel scores were higher when these descriptive terms were used than when the term coarse was selected.

Texture. Texture of waffles from brands A and C was described most frequently by the panel as tender and moist. Although brand B products were described as moist, the terms tender and tough also were used frequently. Occasionally panel members commented that product A was soggy which might be attributed to the fact that more liquid was used in proportion to dry ingredients than in either of the other products evaluated.

Scores for texture of products A and B were considerably lower than that for product C (Fig. 1); A was scored as standard and B slightly below standard. Product C was scored highest for texture, although a high mean value for breaking strength and low moisture content were noted (Table 1).

Color. External color was scored highest for waffles made using brand C (Fig. 1). The term golden brown was used most frequently to describe those waffles (Table 7, Appendix). External color of products made from brands A and B was described as brown most frequently and was scored lower than C (Fig. 1). A dark external color was noted consistently for products A and B regardless of the order of preparation and baking. Ingredient content of the mixes may have been a factor in the color differences.

Scores for internal color were highest for waffles of brand C and lowest for brand B. Internal color of the waffles made from brands A and

C was described as yellow, but brand B was described as white (Table 7, Appendix). Perhaps this was the reason B was scored low for internal color. Panel scores (Fig. 1) and yellowness values (Table 1) for internal color of the products were attributed to the artificial color incorporated into mixes A and C.

Volume. Mean score for volume was lowest for waffles made using brand A and highest for those from brand C (Fig. 1). Waffles from brand A were described as medium in volume slightly more frequently than those made using brand C. Waffles made from brand C were described more frequently as large (Table 7, Appendix).

Quality and acceptability. Differences in quality and acceptability of waffles prepared from the three brands were revealed in the study. On the basis of sensory scores (Fig. 1) products made using brands A and B were most comparable. Waffles made from brand C were scored highest for all characteristics evaluated.

Percentage acceptability of the three products was determined from panel responses (Table 3). An average of 98 percent of the panel marked waffles C as acceptable, indicating they would serve the product for meals. The average acceptability of products made using brands A and B was 44 and 27 percent, respectively.

Preference. Waffles made using brand C were preferred most; whereas, waffles made from brand B were preferred least (Table 4).

Reasons for use. Findings from a survey, conducted by this laboratory regarding use of convenience foods by households in two areas

Table 3 - Percentage of acceptability of waffles made from three commercial mixes

	Waffles		
Replication	Product A	Product B	Product C
1	50	25	100
2	50	63	100
3	71	14	86
4	14	29	100
5	25	25	100
6	50	13	100
7	50	25	100
8	38	25	100
Av.	44	27	98

Table 4 - Order of rank for preference of waffles (ranking range, 1.0 = most preferred to 3.0 = least preferred)

	Waffles		
Replication	Product A	Product B	Product C
1	2.1	2.1	1.0
2	2.5	2.5	1.0
3	1.9	2.9	1.3
4	2.1	2.9	1.0
5	2.5	2.4	1.0
6	1.8	2.5	1.0
7	2.1	2.8	1.0
8	2.1	2.4	1.3
Av.	2.2	2.6	1.1

of Kansas, indicated that the three brands of waffle mix selected for the present study were ones used most frequently by respondents. Reasons given for use of convenience food products included: quality, saving money, saving time and work, and handiness in an emergency.

Quality appeared to be the determining factor in this study when acceptability and preference of waffles were indicated. From panel scores (Fig. 1), and descriptive terms selected (Table 7, Appendix) quality characteristics of waffle products were noted as: delicate aroma; delicate and sweet flavor; fine or medium grain; tender and moist texture; golden brown external color and yellow internal color; and medium or large volume.

Waffles of brand B were least expensive and C most expensive (Table 5). The cost of 2-1/2 c. of batter which yielded 3 servings ranged from $0.23 to $0.40. Calculations were made based on local prices at the time of the study and included all ingredients required for preparation.

Ease of preparation is a prime consideration of many homemakers, and may influence product purchases. In this study least time and effort were expended in preparation of products A and B; all ingredients were combined and then mixed (Table 6, Appendix). Whereas, the method followed for product C involved three distinct operations.

Other factors were not examined in this study, however, handiness of an item and the necessary ingredients in an emergency are also factors which might influence brand selection of commercial waffle mixes.

Table 5 - Cost comparisons of waffles made using 3 commercial waffle mixes

Waffles (mixes)	3 servings (cents)	1 serving (cents)
A	30.0	10.0
B	23.0	7.7
C	40.0	13.3

SUMMARY

This study was designed to determine similarities or differences among waffle mixes used most frequently by respondents in a recent survey of certain Kansas households. Three commercial waffle mixes Aunt Jemima (A), Bisquick (B), and Hungry Jack (C) were prepared, baked, and evaluated by objective and sensory methods. Acceptability and preference of waffles as well as cost and reasons for use were ascertained.

A randomized complete block design with eight replications for each product was used in preparing and presenting waffles for evaluation. Data from measurements were subjected to analysis of variance, and when appropriate least significant differences (LSD, $P < 0.05$) were calculated. Acceptability, preference, cost, and reasons for use were determined, but not subjected to statistical analysis.

Differences in quality and acceptability of waffle products were indicated. Significant differences ($P < 0.05$) in mean values for objective measurements of batters and waffles were noted although no specific trends were indicated. The mean value for specific gravity of batter made from brand A was significantly lower than B or C, whereas, linespread values for batters were significantly lower for C than for A or B. Waffles made using brand A had significantly lower values for volume than those from B or C. Compressibility values were not significantly different. Mean values for breaking strength were significantly lower for waffles made from mix A than from B or C. Waffles made from brand A were significantly more moist than either products from brands B or C. Mean values for reflectance (Rd) were significantly higher for waffles from mix C than from A or B, and values were significantly higher

for products from brand B than A. Significantly lower mean values for redness (a+) were given by waffles made using brand C than A or B. Mean values for yellowness (b+) were significantly higher for products of mix C than A or B.

Significant differences ($P < 0.05$) between waffles were noted for all sensory evaluations except shape. Mean scores for waffles using brand C were significantly higher than A or B for all other characteristics except volume for which scores were significantly higher for C than A, but not significantly higher than B.

Acceptability and preference of waffles were highest for those made from brand C. Calculation of cost revealed waffles made using brand C cost the most. In general, quality, acceptability, and preference were the reasons which determined selection of a given brand regardless of cost.

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APPENDIX

Table 6 - Comparison of formulas and method of preparation for waffles

Waffles	Commercial brands		
	A (Aunt Jemima)	B (Bisquick)	C (Hungry Jack)
Ingredients for 2-1/2 c. batter:	(g)	(g)	(g)
Mix	207	236	278
Liquid (milk)	366	317	183
Egg	75	50	150
Liquid shortening (Wesson oil)	45	30	80
Method of preparation:[a]	1. Waffle iron preheated to #4 until signal light went off. 2. All ingredients beaten until batter was fairly smooth (45 sec.). 3. Baked on hot waffle iron until signal light went out.	1. Waffle iron preheated to #4 until signal light went off. 2. All ingredients beaten until batter was smooth (30 sec.). 3. Baked on hot waffle iron until signal light went out.	1. Waffle iron preheated to #4 until signal light went off. 2. Eggs beaten (30 sec.). 3. Well-beaten eggs, milk and oil combined (15 sec.). 4. Mix added; beaten just until large lumps disappeared (15 sec.). 5. Baked on hot waffle iron until signal light went out.

[a]All mixing was done at speed 3 in a 1-1/2 qt. mixing bowl with a ten-speed Sunbeam Mixmaster®

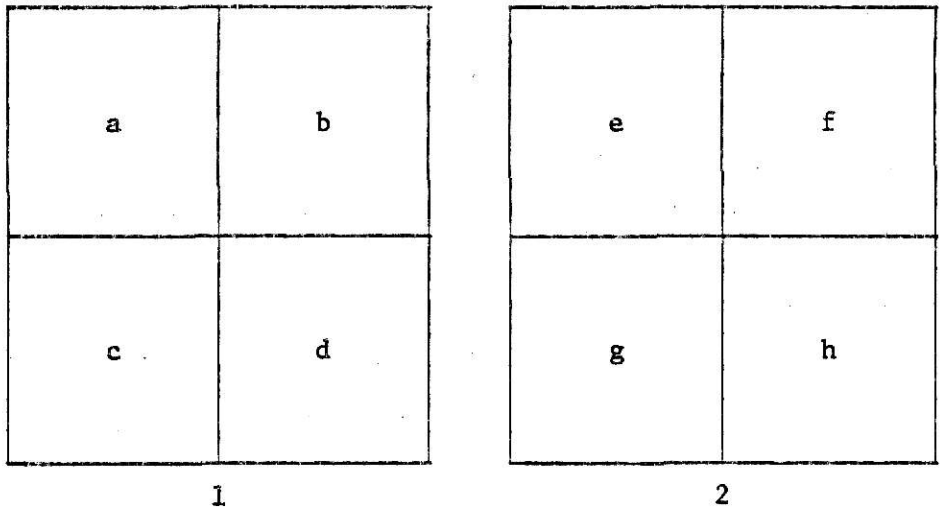

Fig. 2 - Design used in coding sections of waffles from each mix for evaluation.

Form 1 - Randomized complete block design used for evaluation

Replication	1	2	3	4	5	6	7	8
	Waffle section							
Breaking strength	e	a	h	a	b	f	b	d
Volume	b	b	e	g	a	d	d	b
Compressibility	f	d	g	e	c	h	g	e
Color and Moisture	d	f	c	d	g	g	a	c
External appearance	h	c	f	h	d	a	c	f
Palatability (judges #1-4)	c	e	a	f	e	b	h	a
Palatability (judges #5-8)	a	h	d	b	b	c	e	g
Not evaluated	g	g	b	c	f	e	f	h

Form 2 - Score card

Directions: Rate the selected characteristics of the waffle samples according to the key below. Also choose the best adjective that most accurately describes the characteristic rated and place its corresponding letter on the line provided for each sample. (ex. aroma - sample #1: 5a)

Key: 7 Superior 4 Standard 3 Slightly inferior

6 Moderately superior 2 Moderately inferior

5 Slightly superior 1 Inferior

Characteristics	Sample Code 1	2	3
A. General Appearance			
External			
1. Shape: (a) uniform (b) irregular			
2. Volume: (a) large (b) medium (c) small			
3. Color: (a) pale (b) golden brown (c) brown			
Internal			
1. Grain: (a) fine (b) medium (c) coarse			
2. Color: (a) white (b) yellow (c) spotted			
B. Palatability			
1. Aroma: (a) delicate (b) strong			
2. Texture: (a) tender (b) tough (c) moist (d) dry			
3. Flavor: (a) delicate (b) strong (c) sweet (d) salty (e) bitter (f) stale			
C. Acceptability and Preference			
1. Would you consider this product to be acceptable at a meal: + or - ?			
2. Rate the samples in order of preference: (1 - most desirable).			

Table 7 - Frequency of use (%) of selected descriptive terms for each treatment

Descriptive terminology used	Waffles		
	Product A	Product B	Product C
Aroma			
Delicate	37	11	85
Strong	63	89	15
Flavor			
Delicate	8	7	52
Strong	38	43	1
Sweet	2	2	38
Salty	7	19	6
Bitter	34	22	1
Stale	11	7	2
Grain			
Fine	8	0	50
Medium	63	27	50
Coarse	29	73	0
Texture			
Tender	33	21	56
Tough	9	22	4
Moist	48	43	23
Dry	10	14	17
External color			
Pale	3	8	8
Golden brown	15	27	92
Brown	82	65	0
Internal color			
White	1	94	2
Yellow	98	1	98
Spotted	1	5	0
Volume			
Large	45	50	53
Medium	52	50	40
Small	3	0	7
Shape			
Uniform	73	73	65
Irregular	27	27	35

Form 3 - Randomized complete block design for order of preparation and presentation to palatability panel

	Brands		
Replication	A	B	C
1	3	2	1
2	3	2	1
3	1	3	2
4	3	1	2
5	2	1	3
6	3	2	1
7	2	1	3
8	3	1	2

Table 8 - Ingredients of prepared waffle mixes

Commercial brand	Ingredients
A	
Aunt Jemima (Quaker Oats)	Enriched wheat flour (bleached) Corn, oat, rye, and rice flours Leavening Salt Non-fat dry milk Propylene glycol Artificial coloring
B	
Bisquick (General Mills)	Enriched wheat flour (bleached) Shortening (with freshness preserver) Leavening Cultured buttermilk powder Salt Dextrose
C	
Hungry Jack (Pillsbury)	Enriched flour Sugar Rice flour Leavening Buttermilk solids Salt Artificial color

Table 9 - Mean palatability scores of waffles prepared from brand A (scoring range, 7.0 to 1.0 with 7.0 as high and 4.0 as standard)

Replication	Shape	Volume	External color	Grain	Internal color	Aroma	Texture	Flavor
1	4.4	4.5	4.3	4.0	4.4	4.6	3.7	3.3
2	4.9	4.9	4.3	4.3	4.8	4.4	4.0	3.3
3	5.0	4.7	4.4	4.7	4.7	5.1	4.3	4.1
4	5.0	5.0	4.0	3.7	4.6	3.7	3.7	3.3
5	3.6	4.5	3.1	4.1	3.9	3.6	3.9	3.0
6	4.8	4.9	4.0	4.9	4.6	4.6	4.1	3.8
7	4.9	4.9	4.0	4.1	4.1	4.3	4.3	3.3
8	5.0	5.1	4.8	4.5	5.1	4.4	4.4	3.5
Mean	4.70	4.81	4.11	4.29	4.53	4.34	4.05	3.51

Table 10 - Mean palatability scores of waffles prepared from brand B (scoring range, 7.0 to 1.0 with 7.0 as high and 4.0 as standard)

Replication	Shape	Volume	External color	Grain	Internal color	Aroma	Texture	Flavor
1	5.0	5.4	4.6	3.5	4.3	3.5	3.6	3.4
2	4.6	4.9	4.0	3.8	4.0	4.3	4.6	3.9
3	5.1	5.1	4.6	3.4	3.4	4.1	3.6	2.7
4	4.7	5.0	4.5	3.1	3.1	3.4	4.0	2.9
5	4.9	4.9	4.5	3.8	3.4	3.9	3.8	3.1
6	4.1	4.8	2.4	2.8	2.6	2.4	2.3	2.3
7	4.4	4.9	4.1	3.8	3.5	3.8	4.0	3.0
8	4.9	5.0	4.8	3.6	3.8	4.3	3.6	3.5
Mean	4.71	5.00	4.19	3.48	3.51	3.71	3.69	3.10

Table 11 - Mean palatability scores of waffles prepared from brand C (scoring range, 7.0 to 1.0 with 7.0 as high and 4.0 as standard)

Replication	Shape	Volume	External color	Grain	Internal color	Aroma	Texture	Flavor
1	5.0	4.9	5.5	5.6	6.0	5.5	5.5	5.5
2	4.6	5.3	5.3	5.5	5.8	5.6	5.3	5.5
3	4.9	4.9	5.4	5.1	5.7	5.4	4.9	5.4
4	5.1	5.4	5.7	4.8	5.6	5.7	4.1	5.6
5	5.1	5.4	5.6	5.4	5.3	5.6	5.4	6.0
6	5.4	5.3	6.0	5.1	5.9	5.8	5.3	5.5
7	3.9	4.8	5.0	5.5	5.1	5.3	5.3	5.6
8	5.4	5.3	5.4	5.5	5.8	5.6	5.3	5.3
Mean	4.92	5.16	5.49	5.31	5.65	5.56	5.14	5.55

COMPARATIVE EVALUATION OF THE QUALITY AND ACCEPTABILITY OF CERTAIN COMMERCIAL WAFFLE MIXES

by

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B. S., HEc, University of Wisconsin, 1970

AN ABSTRACT OF A MASTER'S REPORT

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This study was designed to determine similarities or differences among waffle mixes used most frequently by respondents in a recent survey of certain Kansas households. Three commercial waffle mixes Aunt Jemima (A), Bisquick (B), and Hungry Jack (C) were prepared, baked, and evaluated by objective and sensory methods. Acceptability and preference of waffles, as well as cost and reasons for use were ascertained.

A randomized complete block design with eight replications for each product was used in preparing and presenting waffles for evaluation. Data for measurements were subjected to analysis of variance, and when appropriate least significant differences (LSD, $P < 0.05$) were calculated. Acceptability, preferences, cost and reasons for use were determined, but not subjected to statistical analysis.

Differences in quality and acceptability of waffle products were indicated. Significant differences ($P < 0.05$) in mean values for objective measurements of batters and waffles were noted although no specific trends were indicated. Significant differences ($P < 0.05$) were noted between waffles for all sensory evaluations except shape. In general, waffles prepared from mix C were scored significantly higher than waffles from mixes A or B.

Waffles from mix C were the most acceptable and preferred most often, but were the most costly of those evaluated. In general, quality, acceptability, and preference were the reasons which determined selection of a given brand regardless of cost.