QUALITY COMPARISON OF REGULAR- AND QUICK-COOK OATMEAL

by

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A MASTER'S REPORT

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MASTER OF SCIENCE

Department of Foods and Nutrition

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INTRODUCTION

The use of convenience foods increased 34% from 1955-65 (Bivens, 1969) but the public still demanded more (Seone, 1971). Convenience foods, as used in this report, refers to foods which have services added to the basic ingredients to reduce the amount of preparation required in the home (Harp and Dunham, 1963). Hoofnagle and Gallimore (1971) reported that consumers have been conditioned to readily accept convenience foods appearing on the supermarket shelf. Quick-cook oats is a good example of a convenience food.

The oats for regular- and quick-cook oatmeal are processed in much the same way. They are cleaned, then dried and roasted for one to one and one-half hours. The roasted oats are placed in a huller where they are thrown against a rubber liner to loosen and remove the hull from the groat, the edible part of the oat kernal. Whole groats are used in the manufacture of the regular-cooking oats; whereas, for quick-cooking oatmeal the groats are cut into two or three pieces. Both products are steamed to soften them slightly, then rolled to the desired thickness (Anonymous, 1967).

The sale of quick-cook oats has surpassed that of the regular-cook products because of ease and quickness of preparation (Anonymous, 1967). Consumers place a high value on time and wish to save it, according to Kinder (1973). Davis et al., (1971) and Muschik (1971) found that time-saving was most important to the majority of consumers who reported using convenience foods. Kolmer and Gartner (1971) reported that quick-cook oatmeal required approximately two-thirds as much preparation time as regular-cook. McWilliams (1966) stated that quick-cooking cereals have disodium phosphate added to decrease the amount of heat required to penetrate the granule. However, the manufacturer of the oatmeal used in the present

study indicated no additives in the quick-cook oatmeal. Thus, the only known difference between the two uncooked products was the thinness of the flake (Anonymous, 1967; Terminology Committee of AHEA, 1971).

In a study conducted at Kansas State University, persons from 2183 households in 2 Kansas counties were interviewed. Hot breakfast cereals were reported to be consumed in 78% of those households with 71% of them using the quick-cooking variety (Tinklin, 1973).

The public is influenced in its acceptance and selection of food by many factors, including convenience and quality of the product (Amerine et al., 1965) as measured by sensory, chemical, and physical means (Palmer, 1972). Quality, according to Stewart and Amerine (1973) can be referred to as the summation of the physical and chemical properties of food, including kinesthetic factors, appearance factors, and odor and flavor components. Harp and Dunham (1963) reported that the quality of a product may be more important than convenience to some consumers. Studies have been reported which compared the quality of several types of convenience foods (Anonymous, 1963; Anonymous, 1970), but none were found which compared the quality of oatmeal products.

The present study was conducted to ascertain any quality differences existing between regular- and quick-cook oatmeal.

MATERIALS AND METHODS

Packages of one brand (Quaker) of regular- and quick-cook oats were purchased at one time from a local supermarket. The oats of each type were mixed, to insure homogeneity of the products, and stored at 18°C until used. A randomized complete block design with 15 replications was used in the preparation of the oatmeal.

Procedure

The manufacturer's directions were followed, except household measures were changed to weights and controls for cooking; these changes were established in preliminary work. The formula included 960 ml water, 6 g salt, and either 141 g regular-cook or 129 g quick-cook oats. The water and salt were brought to a boil in a heavy 2-1/2 qt cast-aluminum saucepan. When ready to cook, oats were added to the salted water gradually during a 30 sec time period and stirred once each second. The stirring pattern used consisted of 5 horizontal strokes, 5 vertical strokes, 5 clockwise circular strokes, and 5 counter-clockwise circular strokes. Stirring was repeated after all oats were added to the water, at the end of each min of cooking, and prior to covering the pans. Quick-cook oats were cooked a total of 1 min 30 sec, whereas regular-cook oats were cooked 5 min 30 sec. Following cooking, pans were covered, removed from the heat, and placed on an electric warming tray for 4 min to maintain uniform temperature until evaluated.

Methods of Evaluation

Objective and sensory measurements were made to evaluate each cooked product.

Objective measurements.

Specific gravity of the cereal, as described by Griswold (1962), was measured at 68°C.

Linespread measurements, at 71°C, were obtained to compare consistency of the products (Griswold, 1962). Samples were allowed to spread for 2 min.

Viscosity of the cereal was measured at 66°C, as ascertained in preliminary work, with a Brookfield (Synchro-Lectric) Viscometer, Model RVT. The torque on a number 6 spindle rotated at a speed of 0.5 rpm was measured by means of a calibrated spring. The spindle was allowed to stabilize for 2 min before readings were taken and converted to centipoise units (cps) using the appropriate correction factor (Jacobson, 1972).

Percentage total moisture content of duplicate samples was recorded after drying to a constant weight for 45 min at 121°C in a C.W. Brabender Rapid-Moisture Tester. Five-g samples were placed in numbered Moisture Tester dishes and spread to a uniform thickness before drying.

Color-differences of reflectance (Rd), greenness (a-), and yellowness (b+) of each sample were determined with a Gardner Color-Difference meter. The instrument was standardized before each measurement with a ceramic tile known to have values of Rd, 67.4; a-, 2.1; and b+, 35.7. One-fourth cup of each product was placed in a Gardner sample cell. Values for each color-difference component were recorded by taking an initial set of readings,

rotating the cell 90° in a clockwise direction, and taking another set of readings. The average of these two sets was used as the color-difference value.

The pH readings were measured with a Beckman pH meter. A slurry was prepared with 10 g oatmeal and 100 ml de-ionized distilled water blended in an Oster one-speed blender for 2 min. Prior to each use the pH meter was standardized with a buffer solution of pH 7.0. Duplicate readings were obtained for each sample of slurry. One reading was taken, the beaker rotated 180° and a second reading recorded. The oatmeal solution was mixed with a magnetic stirring rod 30 sec between measurements.

The sampling plan used for each replication is found in the Appendix, Figure 1.

Sensory measurements.

Sensory scores for aroma, appearance, texture, flavor, and acceptability were assigned the samples by an 8-member taste panel. Samples were coded randomly and scored using a 7-point scale (Form 1, Appendix).

Frequency of use for descriptive terms appearing on the score card was recorded but not subjected to statistical analysis.

Analysis of Data

Data were subjected to the following analysis of variance and least significant differences ($P \leq 0.05$) calculated when F-values for treatment effects were significant.

Source of Variation	D/F
Treatment	1
Replication	14
Error	14
Total	29

Correlation coefficients were calculated to establish relationships between selected objective values and sensory scores, and chi-square statistics computed as a test for heterogeneity among correlation coefficients.

RESULTS AND DISCUSSION

Treatment means, F-values and least significant differences for objective and sensory measurements of the oatmeal products appear in Tables 1 and 2, respectively.

Objective evaluation.

Specific gravity. Significant differences ($P \leq 0.05$) were noted for specific gravity between the regular- and quick-cook oatmeal. The mean value for quick-cook oatmeal was significantly lower than that of the regular-cook possibly because air could be entrapped more readily among the fine flakes (Table 1).

Linespread. Differences in linespread of the products were very highly significant ($P \leq 0.001$). The regular-cook oatmeal had a lower mean value for linespread than the quick-cook. The panel most often noted the quick-cook product formed a softer starch gel than the regular-cook. The difference in values may be attributed to volatile losses during cooking, difference in size of the granules, and/or amount of starch gelatinized.

Viscosity. Very highly significant ($P \leq 0.001$) differences were noted in viscosity of the products. The regular-cook oatmeal had consistently higher viscosity readings than the quick-cook possibly because the larger flakes created more tension on the spring when the spindle was rotated through the product, and/or there was a greater amount of starch gelatinization in the regular-cook product.

Table 1 - Mean values (n = 15), F-values, and LSD's for objective measurements of regular- and quick-cook oatmeal

Measurement	Mean values		F-value	LSD[a]
	Regular-cook	Quick-cook		
Specific gravity	1.05	1.03	6.26*	0.02
Linespread (1/8" units)	0.47	2.06	74.99***	0.38
Viscosity (cps)	1,199,000	782,400	29***	158,247
Total moisture (%)	41.95	43.73	133.25***	0.32
Gardner color-difference				
Rd, reflectance	39.65	40.28	2.57ns	----
a-, greenness	1.67	1.71	0.17ns	----
b+, yellowness	27.99	27.91	0.02ns	----
pH	6.08	6.16	0.32ns	----

ns not significant

a least significant difference at the 5% level

* $P \leq 0.05$

*** $P \leq 0.001$

Percentage total moisture content. Differences between mean values for percentage total moisture content were very highly significant ($P \leq 0.001$). The quick-cook oatmeal was more moist than the regular-cook product. This might be attributed to greater evaporation losses during the longer cooking necessary for the regular cook product or to the absorption of more water during cooking facilitated by the greater total surface area of the quick-cooking oatmeal flakes.

Gardner color-difference. No significant differences were noted for reflectance (Rd), greenness (a-), or yellowness (b+) between the two products. The difference in the granule size did not affect greatly the color components of the oatmeal.

pH. The difference in the mean pH values was not significant, indicating that either there were no additives in the quick-cook product or that any additives present did not change the pH of the oatmeal significantly.

Sensory evaluation.

Mean scores for regular-cook oatmeal were consistently higher than for the quick-cook product (Table 2), but differences between means were not always statistically significant.

Aroma. There was no significant difference in aroma noted between the two products although the mean scores for the regular-cook were higher than those for the quick-cook products. The quick-cook oatmeal was described as having more of a raw aroma than the regular-cook (Table 3). This was attributable to the length of cooking time.

Appearance. No significant difference was noted between mean scores for appearance of the oatmeal products (Table 2). The quick-cook oatmeal was most often said to have a softer starch gel and to be more runny than the

regular-cook (Table 3). The difference in appearance might be attributed to length of cooking time and degree of starch gelatinization of the two products.

Table 2 - Mean values (n = 15), F-values, and LSD's for sensory scores of regular- and quick-cook oatmeal (scoring range 7 to 1, with 7 as high)

Measurement	Mean values		F-value	LSD[a]
	Regular-cook	Quick-cook		
Aroma	5.55	5.33	1.90^{ns}	----
Appearance	5.21	4.84	2.67^{ns}	----
Texture	5.09	4.19	20.20^{***}	0.41
Flavor	5.65	4.53	50.95^{***}	0.32
Acceptability	5.45	4.50	54.43^{***}	0.26

[a] least significant difference at the 5% level

ns not significant

*** $P \leq 0.001$

Texture. Differences in mean texture scores of the products were very highly significant ($P \leq 0.001$, Table 2). The quick-cook product was most frequently described as pasty (Table 3). The thinness of the quick-cook flake might have accounted for loss during cooking of the characteristic oat texture in the quick-cook product. A conference with the judges established the fact that the term cohesive would have described more accurately what they noted as lumpiness in the regular-cook oatmeal.

Flavor. Differences between mean scores for flavor were very highly significant ($P \leq 0.001$, Table 2), with scores for regular-cook oats nearly always being higher than those for quick-cook, as shown in Tables 4 and 5,

Table 3 - Percentage use of selected descriptive terms in scoring regular- and quick-cook oatmeal

Characteristic	Regular-cook	Quick-cook
Aroma		
Strong	17	14
Raw	13	18
Starchy	1	3
No response	69	65
Appearance		
Runny	0	29
Stiff	34	5
Gray	0	4
Non-uniform color	3	2
Pasty	2	7
No response	61	53
Texture		
Lumpy	24	5
Pasty	9	58
Large flakes	2	0
Sticky	1	5
Stiff	2	0
No response	62	32
Flavor		
Raw	12	25
Salty	27	18
Burned	0	2
Bitter	1	1
Starchy	17	23
Bland	6	27
Strong	1	1
Oaty	3	1
No response	33	2

Table 4 - Mean palatability scores for regular-cook oatmeal[a]

Characteristic	Replication														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Aroma	4.7	4.7	5.5	4.8	5.8	5.6	5.6	6.2	5.5	5.2	5.9	5.6	6.3	6.2	5.7
Appearance	4.0	4.2	4.7	4.7	5.3	5.0	5.8	6.2	5.6	5.6	5.0	5.1	5.4	6.3	5.2
Texture	4.7	4.8	5.1	5.0	5.0	4.9	5.4	5.7	5.0	5.0	4.6	5.1	5.3	5.9	5.0
Flavor	5.0	5.5	5.4	5.8	5.0	5.9	5.4	6.3	5.7	5.7	5.7	5.9	6.0	5.5	6.0
Acceptability	5.0	5.5	5.2	5.5	5.2	5.2	5.2	6.2	5.4	5.4	5.6	5.2	5.7	5.8	5.6

[a] characteristic scored on a 7-point scale, with 7 as high

Table 5 - Mean palatability scores for quick-cook oatmeal[a]

Characteristic	Replication														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Aroma	5.0	5.5	5.4	4.7	4.8	5.5	5.0	5.8	5.7	6.0	5.1	5.5	5.3	5.5	5.1
Appearance	5.5	5.5	4.6	5.0	4.8	4.5	5.6	5.6	4.5	5.2	5.0	4.4	4.1	3.7	4.6
Texture	5.5	5.3	3.7	4.2	3.7	4.2	4.8	5.2	3.9	4.0	3.4	3.6	3.9	3.2	4.2
Flavor	5.0	5.5	4.1	4.5	4.5	4.6	4.6	5.0	4.2	4.9	4.1	4.2	4.4	3.5	4.9
Acceptability	5.0	5.2	4.5	4.3	4.3	4.5	4.6	5.0	4.4	4.7	4.1	4.4	4.1	3.7	4.7

[a] characteristic scored on a 7-point scale, with 7 as high

respectively. Panel members most often described regular-cook oatmeal as salty and starchy, and quick-cook as bland, raw, and starchy (Table 3). Differences in flavor might be attributed to the shorter cooking time of the quick-cook product. It lacked the distinct oaty flavor.

Acceptability. Mean scores for acceptability were very highly significantly ($P \leq 0.001$) different (Table 2). Regular-cook oatmeal was scored higher than the quick-cook indicating an overall preference for the longer-cooking product. In general, the regular-cook oatmeal more closely resembled the description of a well-prepared cereal (McWilliams, 1966) than did the quick-cook oatmeal.

Use of selected descriptive terms.

Undesirable descriptive terms for quick-cook oatmeal were checked 62% of the time but for regular-cook only 44% (Table 3). Therefore, it appeared that regular-cook oatmeal was accepted most readily by the panel. This assumption was reflected by acceptability scores.

Relationships between paired measurements.

Pooled correlation coefficients were computed with data from both treatments to establish relationships between paired measurements used to evaluate the oatmeal (Table 6). Correlation coefficients within individual treatments are discussed when the chi-square statistic was significant (Table 7), indicating that treatments in some way affected the relationship between the variables being studied (Snedecor and Cochran, 1967). Only those pooled correlations that were statistically significant ($P \leq 0.05$) will be discussed.

Table 6 - Correlation coefficients for selected pairs of variates for combined treatments of oatmeal

Paired variates d/f = 24	r values[a]
Linespread vs appearance	-0.261
Texture vs flavor	0.688**
Texture vs appearance	0.730**
Texture vs acceptability	0.772**
Appearance vs acceptability	0.674**
Flavor vs acceptability	0.819**

[a] Level of significance: **, $P \leq 0.01$, $r = 0.496$

Table 7 - Correlation coefficients for selected pairs of variates within individual treatments of oatmeal

Paired variates d/f = 12	r values[a]	
	Regular-cook	Quick-cook
Linespread vs appearance	0.261	-0.714**
Texture vs flavor	0.303	0.841**

[a] Level of significance: **, $P \leq 0.01$, $r = 0.661$

In this report, a coefficient between 0.00 and 0.39 was considered low; coefficient between 0.40 and 0.79, moderate; and one of 0.80 or above, high (Faulkner, 1962).

Correlation coefficients for texture vs flavor, texture vs appearance, and texture vs acceptability were related moderately and were highly significant ($P \leq 0.01$, Table 6). Appearance vs flavor correlation coefficients were also moderate and highly significant ($P \leq 0.01$).

Acceptability scores were correlated moderately with scores for appearance and were highly significant ($P \leq 0.01$); whereas, scores for acceptability vs flavor were highly correlated and were highly significant ($P \leq 0.01$). It can be deducted that the flavor of the oatmeal had a greater effect on the acceptability of the product than did the other factors studied.

When individual treatments were considered, linespread of the quick-cook product was correlated moderately, but negatively and highly significantly ($P \leq 0.01$), with appearance (Table 7). The regular-cook product, however, had a low correlation which was not significant between these two attributes.

Texture was related highly to flavor in the quick-cook oatmeal, but had a moderate, non-significant relationship in the regular-cook. This could indicate that texture was a major factor in the scoring of flavor of the quick-cook product, whereas the flavor of the regular-cook oatmeal was a combination of several characteristics.

In general, correlation coefficients indicated that texture, flavor, and appearance were closely related to acceptability of the products.

SUMMARY

Selected sensory evaluations and objective measurements were made to ascertain any quality differences existing between regular- and quick-cook oatmeal. A randomized complete block design with 15 replications was used in the preparation of the oatmeal. Data were subjected to analysis of variance to locate significant differences between the oatmeal products. Correlation coefficients were calculated to establish relationships between selected objective values and sensory scores, and chi-square statistics computed as tests for heterogeneity among the coefficients.

Results of the study indicated that regular-cook oatmeal had more of the quality characteristics of a well-prepared cereal than did the quick-cook product. However, both products were acceptable.

APPENDIX

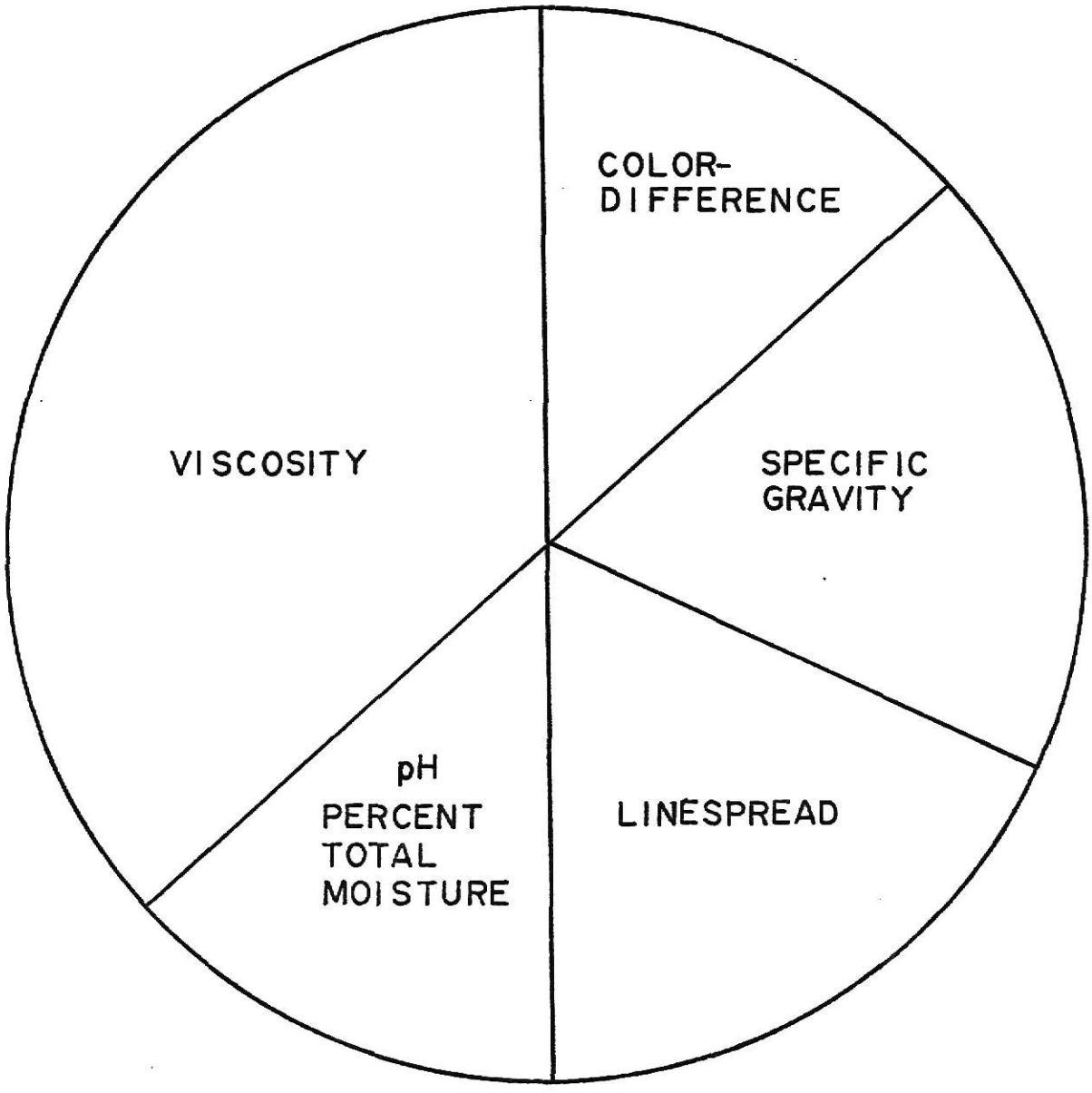

Figure 1 - Sampling plan for objective measurements of oatmeal products

Form 1 - Score card for sensory evaluation of oatmeal products

SCORE CARD
Regular- and Quick-cook Oatmeal

Name _____

Date _____

Characteristic	Key for Scoring 1 2 3 4 5 6 7	Samples A B
1. Aroma	Strong, raw odor ... Light, pleasing odor	
2. Appearance	Runny, stiff, gray or non-uniform color ... Softly piled, uniform color	
3. Texture	Lumpy, pasty ... Uniformly distributed flakes	
4. Flavor	Raw, salty, burned, bitter, strong ... Pleasant oaty taste, delicate	
5. Overall acceptability	Undesirable, poor quality ... Desirable, good quality	

6. Check the characteristics listed below if they apply to each product.

A	Aroma	B	A	Appearance	B	A	Texture	B	A	Flavor	B
__	Strong	__	__	Runny	__	__	Lumpy	__	__	Raw	__
__	Raw	__	__	Stiff	__	__	Pasty	__	__	Salty	__
			__	Gray	__				__	Burned	__
			__	Non-uniform color	__				__	Bitter	__
									__	Starchy	__
									__	Bland	__
									__	Strong	__

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Quick-cook oatmeal had lower mean values for specific gravity ($P \leq 0.05$), spread more ($P \leq 0.001$), was less viscous ($P \leq 0.001$), and had higher percentage total moisture content ($P \leq 0.001$) than the regular-cook product.

Mean scores for oatmeal revealed a more desirable texture and flavor ($P \leq 0.001$) and a greater acceptability ($P \leq 0.001$) for regular-cook than for quick-cook oatmeal.

In general, correlation coefficients suggested that texture, flavor, and appearance were closely related to acceptability of the products.

Results of the study indicated that regular-cook oatmeal had more of the characteristics of a well-prepared cereal than did the quick-cook product. However, both products were acceptable.