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LOW OIL CORRUGATED POTATO CHIP
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- (56) Prior Art Documents
US 4756916
US 4680191
US 4650684
- (57) Claim

1. A low fat potato chip having a fat content of less than about twenty-five weight percent, based on the total weight of the potato chip made from potato slices, a web thickness of about 2 mm, and having a corrugated cross-sectional configuration wherein the value of amplitude/period ranges from about 0.35 to about 0.45 and wherein ridges on one face of the corrugated chip are in-phase with grooves on the opposing face of the corrugated chip.

3. A low fat potato chip having a fat content of less than about twenty-five weight percent, based on the total weight of the potato chip, a web thickness of about 2 mm, and having a corrugated cross-sectional configuration wherein the amplitude ranges from about 0.80 mm to about 2.20 mm; wherein the value of amplitude/period ranges from about 0.35 to about 0.45; and wherein ridges on one face of the corrugated chip are in-phase with grooves on the opposing face of the corrugated chip.

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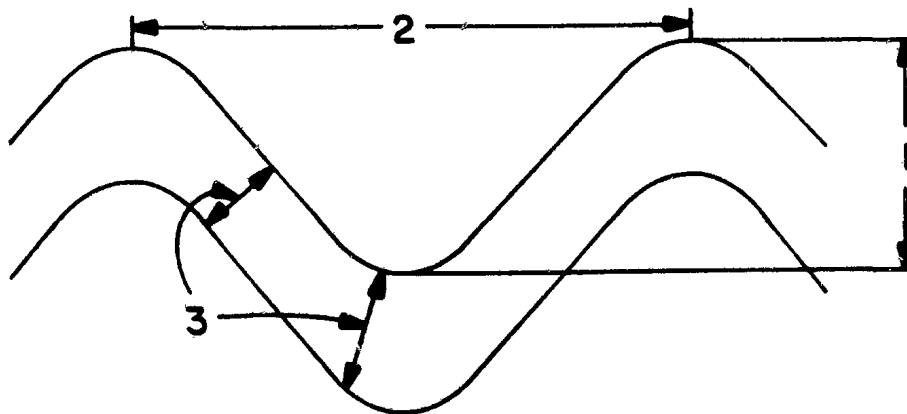
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CORRUGATED

(54) Title: ~~NOVEL~~ ^{CORRUGATED} LOW OIL POTATO CHIP CONSTRUCTIONS



(57) Abstract

Low oil potato chips construction is identified having corrugated cross-sectional configurations (Fig. 1) wherein the value of amplitude/period ranges from about 0.35 to about 0.50 and wherein ridges on one face of the corrugated chip are in-phase with grooves on the opposing face of the corrugated chip.

NOVEL LOW OIL POTATO CHIP CONSTRUCTIONS*Field of the invention*

The present invention relates to novel low oil potato chip products. More specifically, the present invention pertains to low oil potato chip products made from potato slices having specific cross-sectional configurations that provide enhanced textural, flavor and other potato chip characteristics.

Background of the Invention

Potato chip products are popular snack food items that have wide consumer appeal. It is considered that the combination of potato, oil and salt flavors, and the crunchy texture creates the preferred potato chip taste sensation. However, consumers have also expressed concerns for their total dietary intake of fats and oils and view potato chips, with a typical fat content of between thirty and forty weight percent, as other than a health food. In response to this, potato chip manufacturers have sought to produce a potato chip which retains the flavor and texture characteristics of conventional potato chips, but with a significantly reduced fat content.

One example of low fat potato chip processing includes copending and coassigned patent application, U.S. Serial No. 305,256, entitled "Low Fat Potato Chip Process." This disclosure describes an optimized process for producing a low fat potato chip wherein



potato slices are par-fried at a temperature between 149°C and 182°C (300 to 360°F) to a moisture content of from about four weight percent to about ten weight percent; the par-fried slices are exposed to
5 superheated steam maintained at between 138°C and 171°C (280 and 340°F) and velocities of from 488 meters/minute (1,600 ft/min.) to 671 meters/minute (2,200 ft/min.) for from 60 to 120 seconds to remove surface fat from the par-fried slices; and then exposing the de-fatted,
10 par-fried slices to additional dehydrating to finish-drying the slices to less than about two weight percent moisture to yield low fat potato chips.

Other processes for decreasing the fat content of potato chips include British Patent Specification
15 1,519,049 entitled "Improvements in or Relating to Methods and Apparatus for the Preparation of Deep-Fried Sliced Potatoes, So-called Potato Crisps" which teaches a process that includes the use of superheated steam to strip surface fat from fried potato chips; United
20 States Patent No. 4,537,786, entitled "Method of Preparing Low Oil Fried Potato Chips" that discloses the use of hot air blasts to reduce the oil content of potato slices while also finish-drying the slices to a desired moisture content to produce chips; and United
25 States Patent No. 4,721,625 entitled "Process for Preparing Low Oil Potato Chips" which describes par-frying potato slices, deoiling the slices in the presence of saturated steam blasts, and drying the deoiled slices with superheated steam, all in the
30 absence of oxygen, to yield low oil potato chips.

Additional proposals for processing low oil potato chips are known to those familiar with this art. Each of these disclosures teach processing variables that must be controlled in order to yield low fat products.

Unfortunately, when the low fat goal is reached there is also a corresponding reduction in one or more of the organoleptic properties of the product such as flavor, texture, appearance and color. It is also noteworthy that these low oil processing disclosures do not teach processing sliced whole potatoes wherein the potato slice has surfaces that are other than smooth, flat surfaces.

Separate and aside from low fat potato chip processing is technology devoted to slicing whole potatoes wherein the slice surface is other than flat. Examples of different slice surfaces include "wavy cuts" which have smooth regularly undulating surfaces; and "V cuts" which have sharp angular ridges and valleys. Potato chips with these slice surfaces are collectively referred to as corrugated potato chips. Examples of various corrugated chips can be found in United States Patent No. 2,769,715 to Stahmer entitled "Sliced Corrugated Potato Products;" United States Patent No. 4,508,739 to Ryan entitled "Potato Product with Opposite Corrugations of Different Frequencies;" and United States Patent No. 4,650,684 to Penrose, entitled "Reduction in Phase-Locking of Corrugated Chips and Products Thereof."

Although various potato chip structures are known, the field of low oil potato chip technology has concentrated solely on controlling processing variables. With this convergent approach, there still remains a void in the area of low oil potato chips as the ability does not now exist to consistently produce a low fat potato chip that is rated at parity or above to conventional potato chips by consumers.

It is one object of the present invention to provide a low fat potato chip having high consumer

acceptability relative to other low fat potato chips.

It is another object of the present invention to provide a low fat potato chip having consumer acceptability that is about at parity with conventionally prepared potato chips.

It is yet another object of this invention to provide low fat potato chips having novel constructions that enhance the organoleptic properties of the potato chip.

These and other objects of the present invention will become evident to one skilled in the art from the below description of the invention and the appended claims.

Summary of the Invention

The present invention relates to a low fat potato chip product having a fat content of less than about twenty-five weight percent, based on the total weight of the potato chip product, and having a corrugated cross-sectional construction wherein the value of amplitude/period ranges from about 0.35 to about 0.5. As used herein, the terms "low fat" and "low oil" are considered to have an equivalent meaning, referring to a potato chip having less than twenty-five weight percent fat based on the total weight of the potato chip.

The potato chips of this invention may be made by any of the known processes for producing low oil potato chips from potato slices and, when compared to similarly produced low fat potato chips having different amplitude/period values, will exhibit organoleptic characteristics that are preferred characteristics. Using state-of-the-art low oil potato chip processing, low oil potato chips can be made that have consumer acceptabilities that are at least at

about parity with corresponding potato chips having conventional fat contents, which are generally between about 30 and 40 weight percent.

Detailed Description of the Invention

5 As used herein, the following terms referring to the cross-sectional construction of a potato chip shall have the following meaning: "Amplitude" refers to the vertical height of a peak or ridge of a corrugated potato chip as measured from an adjacent valley.

10 "Period" means the distance between the centerlines of two consecutive peaks or two consecutive valleys on one corrugated potato chip surface. "Web thickness" is an average measurement of the instantaneous perpendicular distance between the two opposing faces of a potato

15 chip. The web thickness of a corrugated potato chip can be calculated by dividing the cross-sectional area by the arc length.

 The phrase "low fat potato chip" as used herein refers to a potato chip product having a fat content of

20 less than about twenty-five weight percent, based on the total weight of the potato chip.

 In accordance with the present invention, it has surprisingly been shown that, under about identical preparatory conditions, including similar web

25 thicknesses, low-fat potato chips made from potato slices having differing cross-sectional constructions possess similar low oil contents, but differing degrees of consumer preferences. It has been found that by maintaining the minimum web thickness, which is a

30 function of potato variety and solids, with constructions which have a value of amplitude/period between about 0.35 and 0.50 results in potato chip products which have both low oil content and

organoleptic characteristics that are consistently preferred over other low oil potato chips and are about at parity with conventional oil content potato chips. Preferably the amplitude/period values are between 0.35 and 0.45. It is to be noted that no additional processing considerations are required to produce low oil potato chips having the cross-sectional constructions of this invention, apart from those processing parameters necessary to yield a low oil potato chip of any other configuration.

Brief Description of the Drawings

The present invention will become apparent from the following description thereof when considered together with the accompanying drawings which are set forth as being exemplary of embodiments of the present invention and are not intended in any way, to be limitative thereof and wherein:

FIG. 1 is a cross-sectional view of a potato chip product in accordance with the present invention;

FIG. 2A-C are graphs of consumer acceptabilities of various attributes of low oil potato chips plotted against the value of amplitude/period of the same chips; and

FIG. 3 is a bar graph of overall consumer acceptance for various low oil potato chips having differing values of amplitude/period, and for control potato chips having conventional oil contents.

FIG. 1 portrays a cross-sectional view of a potato chip wherein the ridges on one face are in-phase with the grooves on the opposing face thereof. The cross-section of the potato chip is identified by an amplitude 1, a period 2 and a web thickness 3. In accordance with the present teaching, the amplitude may

range from about 0.80 mm (0.031 in.) to about 2.20 mm.
(0.087 in.), provided that the value of
amplitude/period is within the range of from 0.3 to
0.5. Preferably the amplitude ranges from about 1.03
5 mm (0.040 in.) to about 1.95 mm. (0.077 in.), and the
value of amplitude/period is about 0.35 to 0.45.

EXAMPLES

FIG. 2A-C and FIG. 3 are discussed herebelow with
reference to the following examples which are provided
10 to demonstrate the subject invention and ^{are} not intended
to be limitative thereof. In these examples low oil
potato chips having various cross-sectional
constructions were prepared and evaluated for texture,
flavor and shape, and compared to conventionally
15 prepared potato chips for overall consumer acceptance.

New crop potatoes having a specific gravity of
about 1.082 were peeled and passed through an
industrial slicer, Model CC available from the Urschel
Company, Valpariso, Indiana. The slicer was fitted
20 with various blade configurations to form slices having
different cross-sectional constructions.

The cross-sectional data for each type of chip cut
is shown in Table 1 below, which is based on measuring
the finished low oil and control potato chip products
25 by caliper and shadow-graph measurements.

Unless otherwise noted, all products formed had
cross-sectional constructions wherein the ridges on one
face of the product were in-phase with the grooves on
the opposing face of the product, as depicted in FIG.
30 1, although such in-phase constructions are not
considered to be limitative of the subject invention.
Each slice configuration was cut to have a web
thickness of about 2 mm. Potato slices having about



equal web thicknesses, when fried under similar conditions, have been found to produce low oil potato chips having about equal oil contents. By utilizing slices having about equal web thicknesses, finished
5 chip oil content was removed as a significant variable when the potato chips were evaluated for consumer acceptabilities.

The slices were transferred to a continuous potato chip fryer which contained partially hydrogenated
10 soybean oil. For control chips of conventional potato chip oil content, C-1 and C-2, the frying oil was kept at about 188°C (370°F) and the slices were fried to a final moisture content of about 1.0-1.5 weight percent and an oil content of between 30 and 32 weight percent,
15 based on the weight of the fried chips.

Low fat potato chips were processed by par-frying the potato slices in the frying oil, which was maintained at about 171°C (340°F), to a moisture content of about 10-13 weight percent, based on the weight of
20 the par-fried slices. In each run, the dwell time of the potato slices in the frying oil was adjusted to compensate for slice thickness variations so that the desired moisture content was obtained in the slices exiting the fryer. The dwell time ranged from a
25 minimum of about 110 seconds for Product No. 4 to a maximum of about 170 seconds for Product No. 5.

After par-frying, the slices were introduced as a 7.6cm (3 inch)-thick continuous bed to a de-oiling and dehydrating unit, identified as an LOC-300 available
30 from Heat and Control, Inc., South San Francisco, California. This unit was operated in accordance with the teaching of British Patent Specification 1,519,049, which teaching is discussed hereinabove and which is

incorporated herein by reference. The unit removed oil from, and finish-dried, the slices by means of superheated steam. The temperature of the deoiling unit was maintained at about 149°C (300°F) and
5 superheated steam impinged on the 7.6 cm thick bed of par-fried slices at a speed of about 549 meters/minute (1,800 ft/min). The dwell time of a potato slice in the deoiling unit was about 1.20 seconds and the final
10 moisture content of the potato chips exiting the de-oiling and dehydrating unit ranged from about 1.0 to about 1.7 weight percent, based on the weight of the chips exiting the unit. The oil content of the chips exiting the deoiling and dehydrating unit ranged from about 16 to about 20 weight percent.

15 The so-formed chips were salted in a tumbler utilizing a volumetric feeder. The final oil and moisture contents of each product are shown in Table 1, expressed as weight percents based on the total weight of the finished product.

TABLE 1.
PRODUCT CHARACTERISTICS

	Product No.	Amplitude (mm)	Period (mm)	<u>Amplitude</u> <u>Period</u>	Oil Content (weight percent)	Moisture Content (weight percent)
5	C-1*	-	-	0.00	32.0	0.9
	C-2	1.03	2.73	0.38	30.01	.5
	3*	-	-	0.00	19.9	1.5
10	4	2.07	6.63	0.31	15.8	1.7
	5	1.03	2.73	0.38	18.9	1.2
	6	1.95	4.49	0.43	18.5	1.1
	7	1.82	3.64	0.50	18.3	1.4

15 * - Flat cut chip having approximately smooth slice surface.

The low-fat finished products were then used in consumer testing to determine their relative acceptances based on organoleptic characteristics such as texture, shape and flavor.

20 One-hundred ninety-two respondents evaluated a control plus four of nine samples in a sequential monadic manner. Order of presentation and blocking were randomized. Data were analyzed at the 90% confidence level using the General Linear Models Analysis of Variance. Respondent, sample and replication were removed as sources of variation.

25 The results of testing for the three organoleptic attributes are shown graphically in Figures 2A, 2B and 2C, respectively, as a function of the value of amplitude/period of the products. As is evident in each figure, the cross-sectional construction of the potato chip, as represented by the amplitude/period value, directly influences the acceptance of the characteristic being measured.

30 Favorable responses to each attribute are markedly

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increased within the amplitude/period range of from about 0.35 to about 0.45.

The overall acceptabilities of the low fat potato chips were also compared to the overall acceptabilities of flat and corrugated control potato chips having conventional oil contents. These results are shown in Table 2 below and are depicted in the FIG. 3 bar graph, where the vertical axis is a measure of overall acceptability. In FIG. 3 the Product Number is shown beneath each respective bar. The value of amplitude/period for each respective Product Number is also shown parenthetically. From this Figure, it is appreciated that low fat potato chips having amplitude/period values between 0.35 and 0.5 possess overall consumer acceptabilities that about equal or exceed the comparable values for potato chips with conventional fat contents.

TABLE 2.
SENSORY RESPONSES TO PRODUCTS

Product Overall No.	Texture Acceptability	Flavor Accept.	Shape Accept.	Accept
C-1*	6.6	6.1	6.4	6.0
C-2	6.7	6.5	6.8	6.3
25 3*	5.4	5.6	6.1	5.3
4	5.6	5.7	6.5	5.5
5	6.5	6.1	6.7	6.3
6	6.2	6.4	7.0	6.1
7	6.0	5.8	6.0	5.9

* - Flat cut chip having approximately smooth slice surface.

The invention disclosed herein provides novel low fat potato chips having consumer acceptabilities based on product characteristics that have been heretofore unattainable. It is believed that any of



the variables disclosed herein can readily be determined and controlled without departing from the spirit of the invention herein disclosed and described. Moreover, the scope of the invention shall include all
5 modifications and variations that fall within the scope of the attached claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A low fat potato chip having a fat content of less than about twenty-five weight percent, based on the total weight of the potato chip made from potato slices, a web thickness of about 2 mm, and having a corrugated cross-sectional configuration wherein
5 the value of amplitude/period ranges from about 0.35 to about 0.45 and wherein ridges on one face of the corrugated chip are in-phase with grooves on the opposing face of the corrugated chip.
2. The low fat potato chip of claim 1 wherein the amplitude ranges from about 1.03 mm to about 1.95 mm.
- 10 3. A low fat potato chip having a fat content of less than about twenty-five weight percent, based on the total weight of the potato chip, a web thickness of about 2 mm, and having a corrugated cross-sectional configuration wherein the amplitude ranges from about 0.80 mm to about 2.20 mm; wherein the value of amplitude/period ranges from about 0.35 to about 0.45; and wherein ridges on one face of the corrugated chip are in-phase with
15 grooves on the opposing face of the corrugated chip.
4. The low fat potato chip of claim 3 wherein the amplitude ranges from about 1.03 mm to about 1.95 mm.

DATED this 12 January, 1993

CARTER SMITH & BEADLE

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FRITO-LAY, INC



FIG. 1

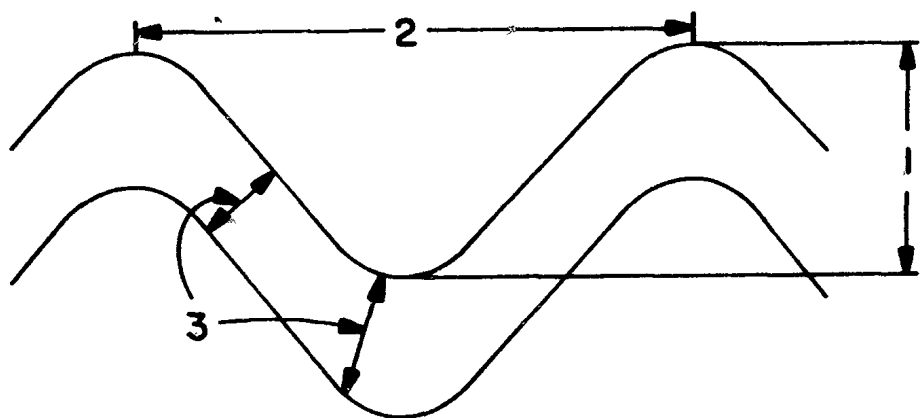
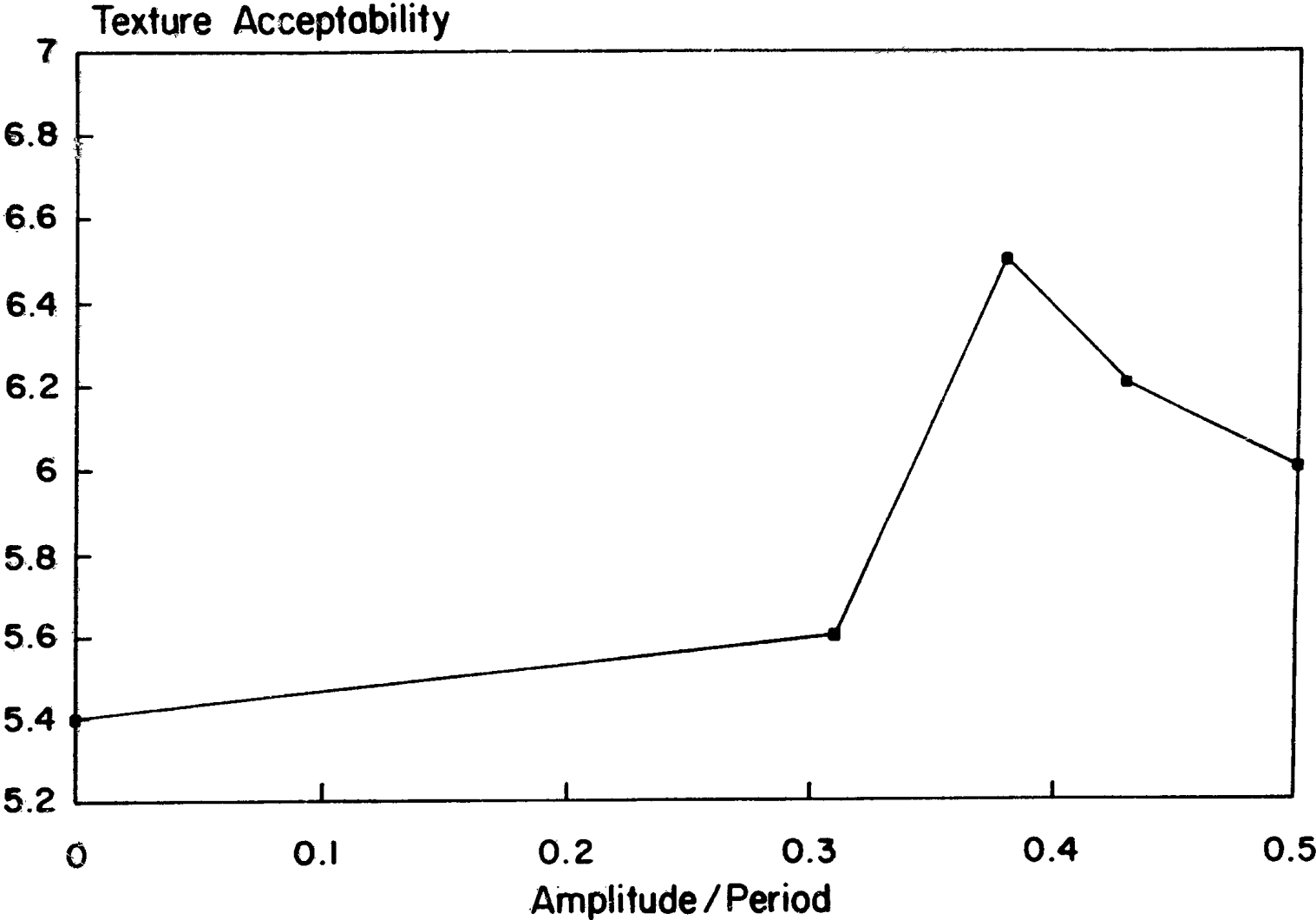


FIG. 2A



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FIG. 2B

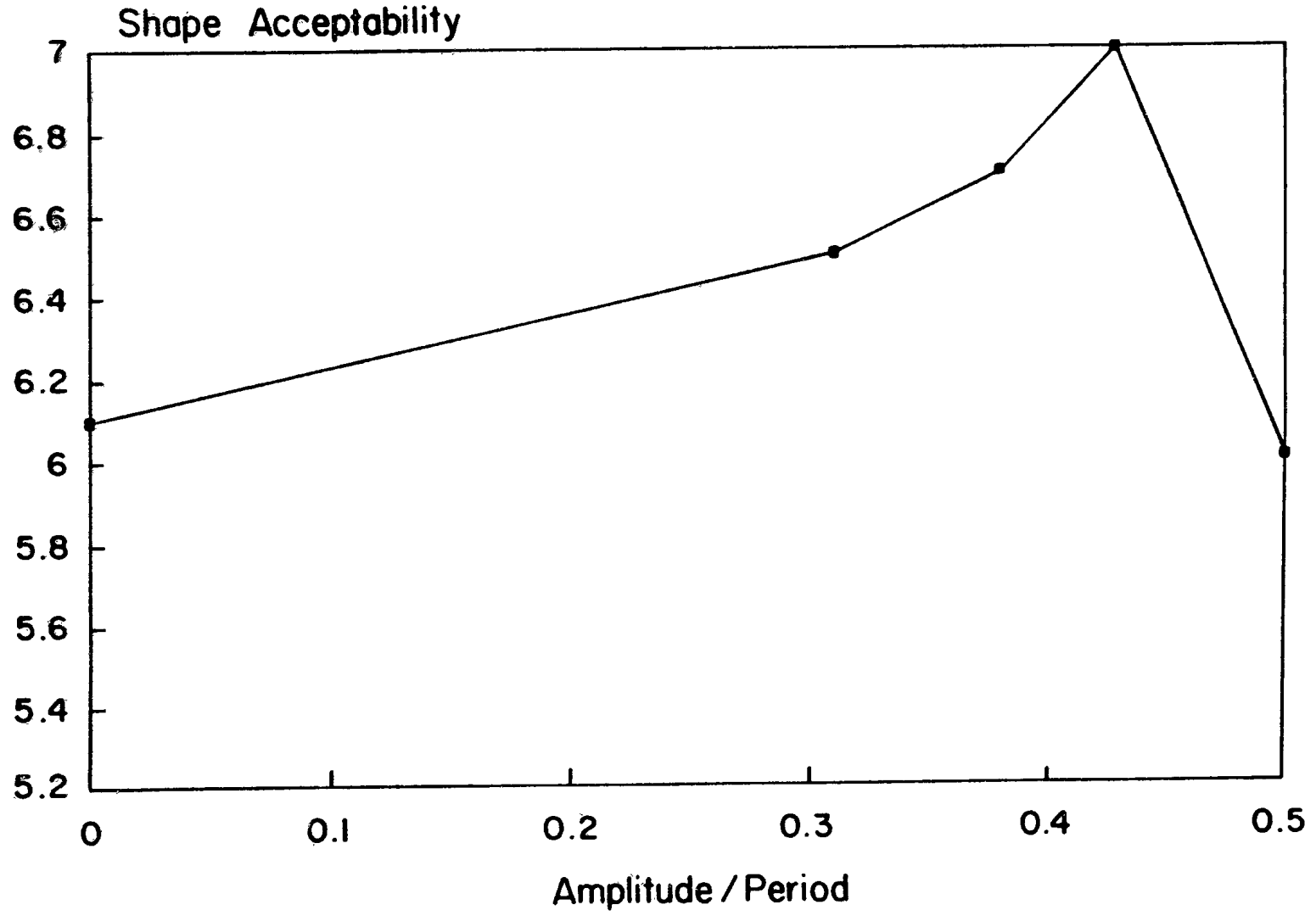


FIG. 2C

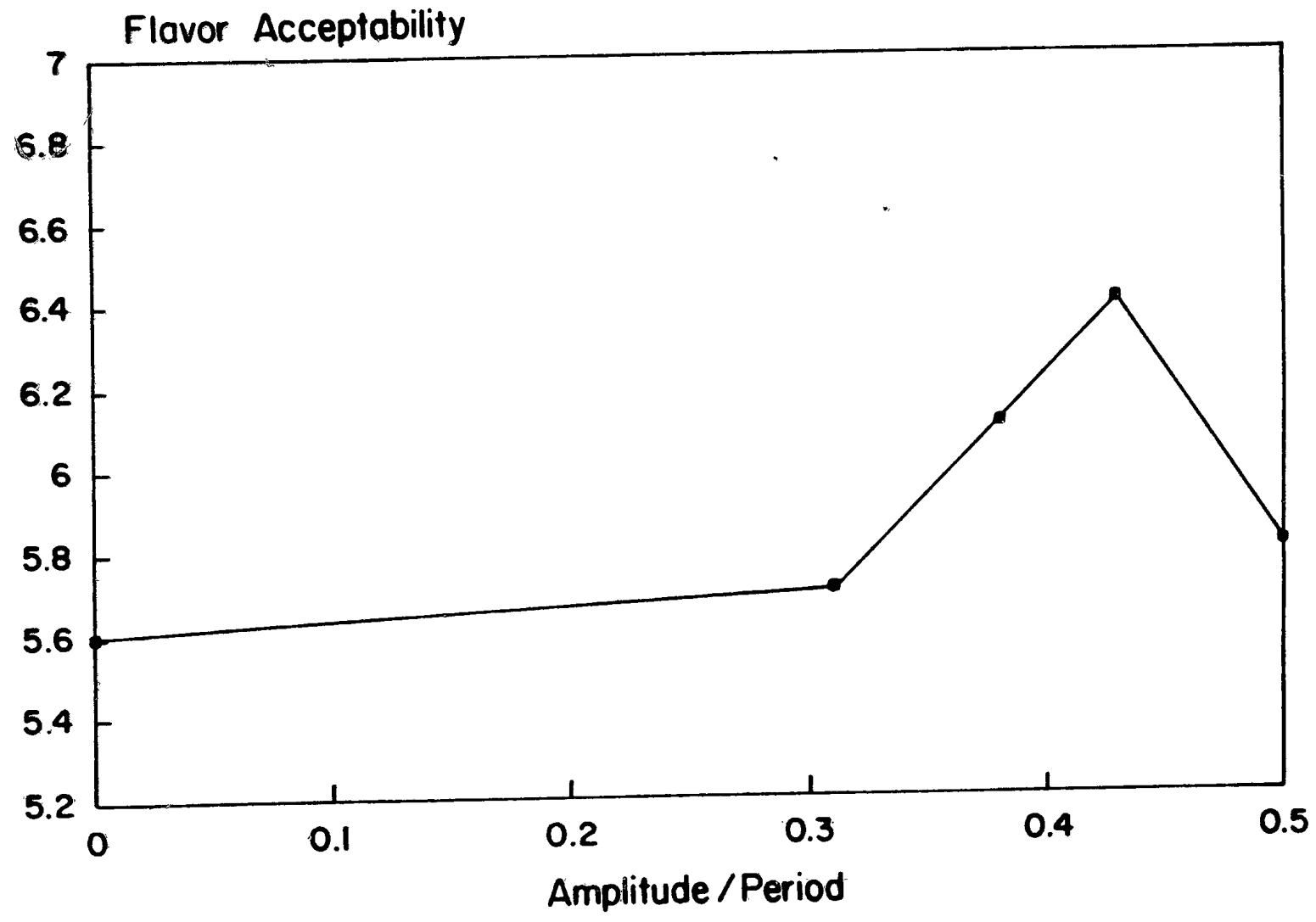
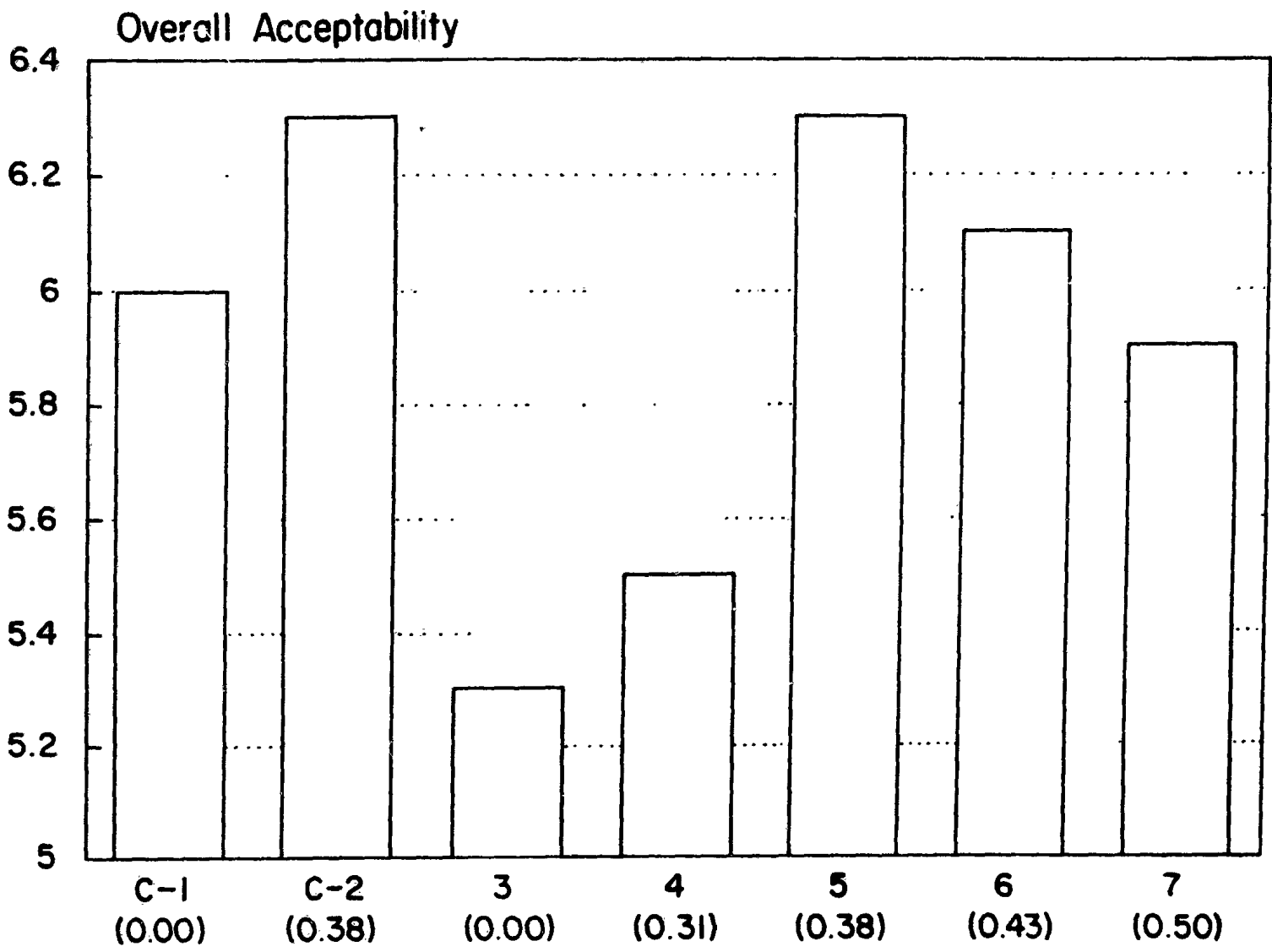


FIG. 3



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INTERNATIONAL SEARCH REPORT

International Application No. PCT/US90/00581

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)
 According to International Patent Classification (IPC) or to both National Classification and IPC
 IPC(5): A23 L 1/217
 U.S. CL. 426/144,637,808

II. FIELDS SEARCHED

Minimum Documentation Searched¹

Classification System	Classification Symbols
U.S.	426/144,438,637,804,808

Documentation Searched other than Minimum Documentation
 to the Extent that such Documents are Included in the Fields Searched²

III. DOCUMENTS CONSIDERED TO BE RELEVANT³

Category ⁴	Citation of Document, ⁵ with indication, where appropriate, of the relevant passages ⁶	Relevant to Claim No. ⁷
Y	US, A, 2,769,715 (STAHMER) 06 November 1956 See entire document	1-5
Y	US, A, 4,508,739 (RYAN) 02 April 1985 See entire document	1-5
Y	US, A, 4,511,586 (FITZWATER ET AL) 16 April 1985 See entire document	1-5
Y	US, A, 4,537,786 (BERNARD) 27 August 1985 See entire document	1-5
Y	US, A, 4,650,684 (PENROSE) 17 March 1987 See entire document	1-5
Y	US, A, 4,680,191 (BUDD ET AL) 14 July 1987 See entire document	1-5
Y	US, A, 4,756,916 (DREHER ET AL) 12 July 1988 See entire document	1-5
Y	CA, A, 701,899 (AEIKKINEN) 12 January 1985 See entire document	1-5

⁴ Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
21 MARCH 1990	11 APR 1990
International Searching Authority	Signature of Authorized Officer
ISA/US	<i>Arthur L. Corbin</i> ARTHUR L. CORBIN