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MICROWAVABLE PASTA IN A BOWL

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BACKGROUND OF THE INVENTION

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Field of the Invention

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The present invention has to do with a convenience food product comprising a microwavable pasta packaged in a container which provides an evenly cooked product in a microwave oven. In a preferred embodiment, the product further comprises an improved hydratable sauce which tends not to form clumps when water or milk is added and requires minimal stirring.

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Description of Related Art

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Microwave cooking is frequently associated with uneven heating and boiling over of liquid contents. One of the ways of minimizing these problems is to cook for a brief time, stir, cook again, stir again, and so forth until the cooking is complete. Consumer preference, however, is to cook

9902150-3**07 MAY 1999**

1 the product once and remove it from the microwave oven in a condition
2 that is ready to eat.

3 Presently available instant or quick cooking pasta and noodles (pasta
4 products) are associated with inferior texture and hydration characteristics.
5 Most of these products are made by extrusion cooking or cooking
6 subsequent to extrusion by immersion in boiling water and/or steam
7 cooking. Extrusion cooking, however, results in deterioration of the pasta
8 texture due to the impact of heat and high shear on the protein matrix prior
9 to and during extrusion. When these products are rehydrated, the texture
10 is mushy or soft, not "al dente". The extrusion cooking process also is
11 costly, requiring sophisticated equipment and control systems. The pasta
12 component of the present invention can be manufactured utilizing less
13 sophisticated, more readily available equipment.

14 U.S. Patent No. 3,251,694 describes a pre-cooked macaroni wherein
15 the dough is made in a conventional manner and the fresh pasta is
16 completely pre-cooked and dried at 300-700°F for about 3 to 9 minutes.
17 The product, however, is expensive because of high processing costs and
18 is limited to pasta shapes that can be extruded with thin walls and still
19 maintain their shape.

20 According to U.S. Patent No. 3,615,677, a rapid cooking pasta is
21 made by extruding the dough and drying to a moisture content of less than

1 12% either with humidified air for 12-48 hours or at a temperature from
2 about 150-300°F for about 5-120 minutes to at least partially gelatinize the
3 starch. Corn flour in an amount from about 45-85% is a critical ingredient
4 because it serves as a binder and it masks the harsh bitter flavor of soy
5 materials. (Another critical ingredient is soy flour in an amount of 15-
6 40%). The specification provides that for high temperature drying the
7 gelatinization of the starch can be effected prior to, during, or after
8 extrusion and that gelatinization should be at least about 10%, with best
9 results at about 10-75%. The product, however, has poor structural
10 integrity, a soft mushy structure and the harsh bitter flavor of soy material
11 is not effectively masked.

12 Several other patents describe pasta products which can be
13 rehydrated quickly but they require complete pre-cooking during the
14 manufacturing process. These include U.S. Patent No. 2,704,723 wherein
15 the fresh pasta is immersed in boiling water before drying, and U.S. Patents
16 Nos. 4,044,165, 4,394,397 and 4,540,592 wherein combinations of heat
17 and mechanical stress are used during extrusion processes to fully pre-cook
18 the pasta products. All of these products suffer from poor textural qualities
19 and lack of "al dente" texture.

1 A method of coating pasta for providing a firm texture is described
2 in U.S. Patent No. 5,144,727. The coating composition is a dried
3 coagulated egg white and an edible oil.

4 Presently available hydratable food products require stirring when
5 water or milk is added in order to disperse the dry particles in the liquid
6 before cooking and stirring also is required during cooking. For example,
7 in a microwave application the product must be removed from the oven
8 and stirred thoroughly at least once before it is completely cooked. Then
9 it is stirred again following cooking.

10 When thick food products such as hydrated sauces are cooked with
11 other ingredients, the thickening agents, starches, gums and the like,
12 usually cause lumps unless vigorous stirring is applied during cooking.
13 This problem is more manifested if the hydrated sauces are prepared with
14 carbohydrate ingredients such as pasta, potatoes or rice. These problems
15 are substantially minimized when sauces according to the present invention
16 are employed.

17 The present invention overcomes the problems associated with the
18 prior art by providing a microwave container having a combination of
19 geometric features which enhance the efficiency and uniformity of
20 microwave cooking by taking into account the dielectric properties of the
21 liquid food products being cooked and the geometry of the container in

1 relation to the microwave wavelength. The design also causes the liquid
2 contents to cook with boiling while preventing boil over.

3 The drawbacks of previously known methods and products are also
4 overcome by the new pasta manufacturing method of the present invention
5 and the new pasta products produced thereby. We have now discovered a
6 method of drying freshly extruded pasta by toasting (i.e. using heated
7 ambient air without added moisture) pasta under controlled conditions to
8 prepare a product having excellent appearance and texture with superior
9 cooked yield and short cook times.

10 The method of making the pasta products of the invention has lower
11 initial capital equipment requirements and lower ongoing manufacturing
12 cost attributed to shorter drying times. The invention also permits
13 manipulation of the processing conditions to obtain a wide range of pasta
14 densities and textures from soft to firm. Accordingly, the pasta products
15 of the invention can be made to have the "al dente" texture of conventional
16 pasta or a softer or firmer texture if desired.

17 All percentages and ratios set forth herein are by weight/weight
18 unless designated otherwise. All percentages of ingredients used in recipes
19 to prepare the pasta products of the invention are based on the total weight
20 of ingredients prior to the addition of water to make the dough.

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SUMMARY OF THE INVENTION

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The container of the invention is in the form of a bowl having a bottom portion and a side panel and the bowl is dimensioned to preclude the establishment of a resonance (standing wave) which would result in an unpredictable microwave heating, by having a base in the shape of a torus with a diameter large enough to minimize or preclude internal resonance in a liquid-containing food. The diameter also is small enough to permit effective microwave cooking of the contents.

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The bottom portion of the bowl comprises a central segment and an outer segment with the central segment being in the form of a push-up in the shape of a section of a sphere. The push-up extends to a bottom panel along a first bottom radius and the bottom panel extends to the side panel along one or more than one additional bottom radii (i.e., at least a second bottom radius). Accordingly, the outer segment is comprised of the first bottom radius, the bottom panel and one or more than one additional bottom radii. In one embodiment, the first bottom radius and the one additional bottom radius (i.e., the second bottom radius) are the same and the radius extends continuously from the push-up to the side panel forming a curved bottom panel.

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The side panel is tapered outwardly from the bottom as it extends

1 toward an opening at the top of the bowl and a rim is provided at the top
2 in the form of a flange with a rolled outer edge to provide a surface for
3 adhering a lid and to add structural strength.

4 Externally at the bottom of the bowl a bottom rib is optionally
5 provided to raise the bowl slightly off the shelf of the microwave oven so
6 that heat loss from the bowl to the shelf of the oven is minimized.

7 The bowl can be disposable or reusable and is produced by
8 conventional processing techniques for molding of any suitable plastic
9 material, for example, injection molding, thermoforming and the like.

10 The toasted pasta products of the present invention have improved
11 product texture and appearance and can be rehydrated quickly by
12 microwave cooking, adding hot or boiling water or by conventional stove
13 top preparation. The products are partially pre-cooked, having a degree of
14 gelatinization from about 15% to about 80%, preferably from about 25%
15 to about 75%. The products also have a moisture content of less than about
16 13%, i.e. from about 2% to about 13%, and have the appearance (size and
17 shape) of regular dry pasta even when they are extruded from thin wall
18 dies. The products have a low density, from about 0.600 to about 1.05
19 grams/cubic centimeter ("g/cc"), preferably from about 0.75 - 1.05 g/cc and
20 this contrasts with prior art pastas which have densities greater than about
21 1.3 g/cc. The products also have a stabilized pasta matrix wherein the

1 starch is partially gelatinized and protein is partially denatured in such a
2 way as to produce a porous internal structure that is unique in the art.
3 Scanning electron micrographs reveal an open "sponge like" structure
4 where products produced with prior art technologies yield a dense compact
5 structure. The structure of the products of the invention is also believed to
6 be responsible for the superior cooked yields which are from about 315%
7 to about 450%, preferably from about 330% to about 425%.

8 The manufacturing process for making the pasta of the invention is
9 carried out by toasting freshly extruded or sheeted pasta at a temperature
10 from about 180°F to about 350°F for from about 1 to about 25 minutes,
11 preferably at from about 210°F to about 310°F for from about 2 to about
12 15 minutes. Toasting can be conducted in more than one zone and a
13 heating with steaming step can be used just prior to the first toasting zone.
14 When heating with steaming is used, the temperature in that step must be
15 at least 212°F to cause expansion of the pasta and it can be as high as about
16 350°F. When there is no heating with steaming step, the minimum
17 temperature in the first (or only) toasting zone also must be 212°F to cause
18 expansion of the pasta.

19 The freshly extruded or sheeted pasta has a moisture content from
20 about 15% (semi-moist) to about 35% (wet/moist) before toasting. It is a
21 theory of the invention that higher dough moisture levels facilitate the

1 expansion of the protein starch matrix before it is stabilized by partial
2 denaturation of the protein and partial gelatinization of the starch.
3 Increased dough moisture produces more steam vapor or leavening effect,
4 resulting in pasta with a more porous, less dense structure. This structure
5 is fixed by heat that, along with higher moisture content in the early stages
6 of toasting, acts to denature protein and to increase the rate of starch
7 gelatinization.

8 The granular food product of the invention is hydratable to make
9 sauces, soups or similar food products. The product is in the form of
10 granules wherein more than about 90%, preferably more than about 98%
11 have a particle size from about 1000 microns to about 175 microns (i.e.
12 from about 18 to about 80 mesh based on the United States Standard
13 [ASTME 11-61] ("USS") sieve system). In other words, more than about
14 90%, preferably more than about 98%, pass through an 18 mesh sieve and
15 are retained on an 80 mesh sieve.

16 The granules are both hydrophilic and hydrophobic. The
17 hydrophobic characteristic causes the particles to disperse when water or
18 milk is added but it does not prevent the absorption of the water or milk
19 because the particles also retain their hydrophilic character. This is
20 contrasted with prior art hydrophilic dry mixes which absorb water rapidly

1 and form clumps which must be physically dispersed by agitation or
2 mixing.

3 Various ingredients can be employed to make the granular product
4 depending upon the desired flavor and end use. An essential ingredient,
5 however, is an emulsifier such as lecithin, mono or diglycerides or other
6 food grade emulsifiers which are capable of imparting hydrophilic
7 characteristics to the granules. Accordingly, the granular product of the
8 invention can contain from about 2% to about 55%, preferably from about
9 18% to about 35%, fat or fat substitutes or a combination thereof. Other
10 ingredients can include crystalline ingredients such as sugar, salt, citric acid
11 and substitutes therefor; dairy ingredients such as dry milk, cheeses, cream
12 powders and the like; spices, natural and artificial flavors, and thickening
13 agents such as starches (native, modified, waxy, etc.) and vegetable gums.

14 As a first step, all of the ingredients, except for the heat sensitive
15 ingredients and binders, are mixed in a high shear or fluid bed mixer to
16 make a dry mixture. The dry mixture then is heated to the melting point of
17 the fat component or up to about 3°C above the melting point, and then it
18 is coated with a first binder composition to make a first particulate
19 composition. The first binder composition is applied by spraying during
20 mixing using conventional means such as a high shear mixer or a fluidized
21 bed. Spraying is conducted through a conventional nozzle. The size of the

1 nozzle orifices will determine the size of the droplets and, accordingly,
2 product particle size. The temperature in the fluidized bed is maintained
3 at from about 20°C to about 50°C.

4 The first binder composition is water or an aqueous solution which
5 can contain as ingredients from about 0% to about 35% of soluble starch,
6 5-20 D.E. maltodextrin, dextrose, sugar (sucrose) or salt or any
7 combination of two or more than two of such ingredients.

8 Following the formation of particulates with the first binder, the first
9 particulate composition is dried to a moisture content of from about 2% to
10 about 6% at a temperature from about 35°C. to about 60°C. using fluidized
11 drying or drying under a vacuum to make a dried first particulate
12 composition.

13 The dried first particulate composition is cooled using cool air or a
14 cold jacketed mixer to ambient temperature or from about 15°C. to about
15 40°C and then the heat sensitive ingredients such as natural and artificial
16 flavors, spices and protein compounds (e.g., albumin, globulin, egg protein
17 or whey protein concentrate) are added and mixed therewith for from about
18 1 to 3 minutes using a fluid bed, impeller/chopper or similar mixer.
19 Following mixing, a second binder is applied in the same manner as the
20 first binder. The second binder is comprised of: (1) the emulsifier and, (2)
21 an oil and/or another first binder composition.

1 After the particles are coated with the second binder, they are a
2 hydratable granular product ready for use to make a sauce according to the
3 invention. The granular product is hydrated along with the pasta of the
4 invention by adding milk or water, gently stirring, heating to cook and
5 hydrate and then gently stirring again before eating.

6 Microwave preparation methods are used in conjunction with this
7 invention to achieve fast hydration and completion of the cooking process
8 (further protein denaturation and starch gelatinization).

9 The convenience food product of the invention contains at least one
10 serving of pasta and can contain several servings. For one serving, the
11 serving size can be up to about 75 grams of dry (not rehydrated) pasta and,
12 generally it will be from about 45 to about 75 grams, preferably from about
13 55 to about 65 grams of dry pasta. Of course, larger servings can be made
14 to accommodate two or more consumers and small servings can be made
15 as a snack or side dish.

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17 **BRIEF DESCRIPTION OF THE DRAWINGS**

18 Figure 1 is a side elevational view of the bowl of the invention.

19 Figure 2 is a bottom elevational view of the bowl of the invention.

20 Figure 3 is a section view of the bowl of the invention.

21 Figure 4 is a perspective view of a lid for the bowl.

1 Figure 5 is a section/schematic view illustrating the bowl of the
2 invention in a microwave oven.

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4 Figure 6 is a section view of a bowl of the invention having a curved
5 bottom panel.

6 Scanning electron microscopy was used to make photomicrographs
7 of cross-sections of the pasta of the invention and previously known pastas.
8 Photomicrographs were obtained using secondary electrons at a
9 magnification of 35 times normal at 10,000 volts. Pieces of pasta were
10 snapped in half by hand to obtain cross-sectional fractures. About 1/4 inch
11 below the fracture, each piece was cut with a scalpel to provide a flat
12 surface for mounting on an aluminum stub that fits within the scanning
13 electron microscope ("SEM"). Each mounted sample was gold coated in
14 a sputter coater and then transferred to the SEM chamber.

15 Figure 7 is a SEM photomicrograph of a pasta of the present
16 invention made according to Example 10 herein.

17 Figure 8 is a SEM photomicrograph of a pasta made according to
18 U.S. Patent No. 3,615,677, Comparative Example 1 herein, and dried for
19 15 minutes at 225°F.

20 Figure 9 is a SEM photomicrograph of the same pasta as made for
21 Figure 2, but with drying for 3 minutes at 300°F.

1 Figure 10 is a SEM photomicrograph of a commercially available
2 pasta product that is said to rehydrate quickly.

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4 **DETAILED DESCRIPTION OF THE INVENTION**

5 A preferred embodiment of a container of the invention in the form
6 of a bowl 10 is illustrated in Figures 1 - 3. Bowl 10 is comprised of a
7 generally circular bottom portion which comprises a push-up 12 having an
8 apex 13 on the central axis X-X of the bowl. (Sprue 14 may be left at the
9 apex 13 on the underside of the push-up 12 if the bowl is manufactured
10 using an injection molding process.)

11 Push-up 12 comprises a section of a sphere. The push-up increases
12 the surface area of the bowl adjacent to the contained food so that the
13 probability of microwaves entering the bowl and heating the food is
14 increased. Bottom panel 11 extends to push-up 12 along first bottom
15 radius 15 which is smooth and without sharp edges because sharp edges
16 within the bowl can cause uneven cooking and they can contribute to
17 boiling over. Smooth radii, in contrast to sharp edges, facilitate the
18 movement of liquid as it heats. Bottom panel 11 also extends along second
19 and third bottom radii 16 and 17, having a substantially frusto-conical
20 portion 11a therebetween, said frusto-conical portion having a smooth
21 surface on the inside of the bowl and a plurality of lower ribs 30 radially

1 disposed on the outside of the bowl. Lower ribs 30 can extend beyond
2 frusto-conical portion 11a as illustrated in Figure 1 wherein they extend
3 over the exterior of radii 16 and 17. The smooth inside surface of frusto-
4 conical portion 11a and radii 16 and 17 are without sharp edges for the
5 same reasons as explained above. Lower ribs 30 provide an area on the
6 outside of the bowl which can be handled when the bowl is hot with
7 reduced transfer of heat to the consumer's hands.

8 Portion 11a extends along radius 17 to side panel 18 and side
9 panel 18 tapers outwardly away from axis X-X, as it extends from the
10 bottom portion toward an end opening defined by rim 19. The taper of the
11 side panel has a sufficient slope to release the steam which will be
12 convected up the inside walls during cooking. The outer segment of the
13 bottom portion also has a doughnut-like shape which assists in this
14 convection by having a lower temperature than the area about the push-up.
15 The shape of the bottom of the bowl also provides an area in which dry
16 ingredients can collect. With the addition of water, the ingredients
17 rehydrate in a concentrated area and rehydrate faster.

18 Rim 19 has a flat portion 20 which substantially lies in a plane
19 normal to axis X-X and which facilitates sealing a lid 60 (Fig. 4) on top of
20 the bowl 10. Conventional lid materials and sealing adhesives can be
21 employed as will be apparent to those skilled in the art. The rim 19 has a

1 rolled outer edge to provide strength so that the consumer can lift the
2 bowl 10 using the rim, particularly after cooking when the bowl may be
3 somewhat softened from heating. Upper ribs 31 are radially disposed on
4 the exterior of the side panel of the bowl and extend downwardly from rim
5 19 to provide an area on the exterior of the bowl which can be handled
6 when the bowl is hot with reduced transfer of heat to the consumer's hand.
7 The upper ribs 31 are sufficiently spaced from lower ribs 30 to provide an
8 area 32 for labeling.

9 Optional bottom rib 21 is disposed on the underside of bottom
10 panel 11 to raise bowl 10 slightly off the shelf 47 of the microwave oven
11 40, thereby reducing the transfer of heat from the bowl to the shelf by
12 providing air insulation.

13 Figure 6 illustrates an embodiment of the invention having a curved
14 bottom panel 11. In this embodiment, radii 15, 16 can be the same or
15 different and when they are different the curve can be in the shape of an
16 ellipse. Other than the shape of the bottom, this embodiment can have all
17 of the features of the aforesaid embodiment. For example, lower ribs can
18 be radially disposed on a portion of the exterior of the bottom panel
19 extending downwardly from the side panel toward a low point (i.e., the
20 perigee or point of contact) of the bottom panel.

1 In microwave ovens, energy enters into an oven cavity through a
2 feed slot. The slot can be on the top, bottom or side, and energy is reflected
3 off the walls and bottom of the oven and into the product being heated.
4 When a conventional bowl is placed in a microwave oven, a minimum
5 amount of energy is reflected from the bottom of the oven into the bowl
6 because the bowl bottom is relatively small in area and the shelf is only
7 raised off the bottom by a short distance:

8 According to the present invention, the spherical section (push-up
9 12) increases the overall exposed area of the bottom portion of the bowl,
10 providing greater area for microwave energy to enter the bottom of the
11 bowl. Push-up 12 also reduces the thickness of the product to be heated in
12 the center.

13 The geometry of the bowl causes the portion of the contents which
14 fill the section below a plane normal to axis X-X and intersecting push-up
15 12 at apex 13 (plane Y-Y in Fig. 5) to be cooler than the contents above the
16 push-up 12 and thereby promotes convective rotation of the liquid-
17 containing contents. The slanted walls of the bowl and the radius in the
18 bottom of the bowl, below plane Y-Y permit the dissipation of the pressure
19 that builds up from boiling, which is created by the amount of energy
20 induced into the bowl. With a wider top diameter than the bottom, the less
21 vigorously the product will boil and this helps to avoid bumping.

1 (Bumping is a build up of pressure in a region of a liquid that becomes
2 superheated and then explodes causing the container to jump and produce
3 a thumping or bumping sound. Vertical bowl or cup walls prevent the
4 gradual release of pressure and tend to bump more frequently.)

5 Figure 5 illustrates a microwave oven having a feed slot at the top
6 and shows how microwave energy can be directed into and through the
7 bottom of the cooking container. When bowl 10 is placed on shelf 47 in
8 microwave oven 40 to cook the contents 50, microwave energy enters the
9 oven from feed slot 46 and some of the energy is emitted in the direction
10 of arrows 41. This energy is reflected off walls 44 in the direction of
11 arrows 42 and is again reflected off bottom 45 in the direction of
12 arrows 43. Accordingly, energy is ultimately directed into and through the
13 spherical section of push-up 12 to heat contents 50. When contents 50 are
14 sufficiently heated, the geometry of the bowl causes controlled boiling to
15 occur without boil over. The controlled boil is achieved by the uniform
16 distribution of heat, the lack of sharp corners within the bowl and the
17 tapered sides 18. Bumping is accordingly avoided and the risk of boil over
18 is minimized.

19 Geometrically, when viewed from the bottom, the bowl of the
20 invention has a torus (doughnut) shape. The effective circumference of the
21 torus should be greater than a whole number of half wavelengths in order

1 to avoid or minimize the occurrence of so called ring-resonance.
2 Accordingly, in conventional microwave ovens which operate at a
3 frequency of about 2,450 megahertz (MHz), the resonance lengths to be
4 avoided in terms of effective diameter of the torus are about 60, 120 and
5 180mm. (Since there is some wave penetration into a dielectric, its
6 "microwave diameter" becomes slightly less than its geometrical diameter.)
7 The effective diameter of the torus, therefore, must be large enough to have
8 an antiresonant effect. For conventional microwave ovens, the effective
9 diameter must be greater than 60mm, preferably greater than about 65mm,
10 so that the effective circumference of the torus (at the effective diameter)
11 becomes antiresonant. (If a microwave oven operated at a frequency
12 different from about 2,450 MHz, the effective diameter would be adjusted
13 accordingly, as would be apparent to one skilled in the art.) As a practical
14 matter, for efficient microwave heating, the effective diameter of the torus
15 also should be less than about 100mm.

16 A torus has a centerline diameter and a body diameter. For
17 definitional purposes in the present specification, the effective diameter is
18 measured at the outer line of contact of the bowl with the shelf of the
19 microwave oven when the contents of the bowl include a substantial
20 amount of water. (Effective diameter is measured at this line when the
21 contents of the bowl are products containing liquid as defined herein and

1 this is based on the dielectrics of the water, a load with a high dielectric
2 constant. As the load becomes dryer, the effective diameter is measured at
3 a higher line (away from the bottom panel and toward the end opening)
4 defined by a plane normal to the X-axis which intersects the outer diameter
5 of the torus. Accordingly, for a semi-dry load (i.e., a lower dielectric
6 constant load) the effective diameter could be measured at the average
7 radius of curvature.) When an optional bottom rib 21 is disposed on the
8 underside of bottom panel 11, however, the rib is not considered as
9 defining the line of contact for purposes of measuring the effective
10 diameter. Accordingly, the effective diameter is measured at the place
11 where the outer line of contact would be in the absence of bottom rib 21.

12 The effective diameter of the torus of the bowl of the present
13 invention is the distance d illustrated in Fig. 3 for products containing
14 liquid. The bowl of the invention accordingly has a torus with an effective
15 diameter sufficiently large to have an antiresonant effect. In the preferred
16 embodiment of the invention, the diameter of the torus is more than 60mm,
17 preferably more than about 65mm, and less than about 100mm.

18 The bowl can be manufactured using any food grade materials
19 which can withstand the temperature of boiling water. Various polymers
20 and polymer blends are suitable and they can include polyethylene
21 terephthalate, polycarbonate, polyacrylonitrile, nylons, glass,

1 polypropylene and polyethylene. A preferred material used to make the
2 bowl is polypropylene and this can have high density polyethylene mixed
3 therein to increase resistance to impact breakage at low temperatures.

4 The microwavable pasta product of the invention can be
5 manufactured using conventional ingredients. A pasta dough is made with
6 wheat flour and water and, optionally, with other conventional ingredients
7 using known processing techniques such as extrusion or sheeting.
8 Accordingly, the ingredients are combined and hydrated with sufficient
9 water to attain the desired consistency and kneaded to make the dough.
10 The dough can be formed into the desired shape by extrusion through a die
11 plate or by sheeting and then it is cut into pieces of the desired size.

12 The ingredients of the pasta of the invention comprise wheat flour
13 selected from the group consisting of semolina, farina, durum, hard wheat
14 and soft wheat flours and pasta regrind from wheat based pastas and the
15 like. Alternate flours such as those from rice and corn can be employed in
16 amount from 0% to about 15% and preferably less than about 10%.
17 Starches from sources such as rice, corn or potato also can be employed in
18 amounts from 0% to about 20%, preferably less than about 15%. Protein
19 sources can be optionally added in amounts from 0% to about 10% and
20 when they are used they typically are added in amounts of at least about
21 0.5%. Typical protein sources include wheat gluten, milk protein, soy

1 protein and eggs in any form including whole eggs, egg whites, powdered
2 eggs, powdered egg whites and the like. A variety of natural and artificial
3 flavors, herbs, spices, cheeses and the like also can be employed in
4 amounts from 0% to about 15% and when they are employed they typically
5 are added in amounts of at least about 0.1%.

6 Traditional vacuum levels for pasta dough extrusion are about 22
7 inches mercury (Hg). According to the present invention, however,
8 extrusion is conducted at ambient pressure levels (no vacuum) or at low
9 vacuum, i.e. less than about 12 inches Hg. When vacuum is employed, the
10 vacuum is maintained in the mixing chamber and screw conveying
11 chambers of the extruder. The ambient extrusion without vacuum or with
12 low levels of vacuum causes the extruded dough to be produced with many
13 evenly distributed fine air cells. These air cells act as nucleation sites for
14 air expansion and, more importantly, for moisture vapor to collect and
15 expand to create a porous matrix during toasting. Using a full vacuum (i.e.
16 traditional levels) according to the process of the invention produces a
17 product having an uneven internal structure and an uneven external
18 appearance.

19 The expanded cell structure is responsible for a porous pasta product
20 (pasta or noodle) structure that creates an attractive product (having the
21 appearance of regular pasta) and insures faster hydration during preparation

1 by microwave, hot or boiling water pour over preparation or conventional
2 stove top preparation.

3 In practice we have found that the moisture content of extruded
4 pasta products before toasting can be varied from about 15% (semi-moist)
5 to about 35% (wet/moist). Moisture content at the higher end of the range
6 is preferred when a faster rehydration time is desired. This is attributed in
7 part to a slightly higher degree of starch gelatinization (cooking) that
8 occurs when more moisture is available during toasting. Increased
9 moisture also increases the expansion of the protein-starch matrix during
10 toasting to create a "sponge like" structure that is also responsible for the
11 short cook times achieved by this invention.

12 In one example, pasta produced by this invention decreased
13 hydration time versus conventional pasta by 3 minutes and eliminated the
14 starchy, uncooked texture and flavor associated with the undercooked
15 conventional pasta being used as a comparison. Overall, the decreased
16 cook times of this invention are the result of the partial cook (partial
17 gelatinization) of the starch and, more importantly, the result of the open
18 "sponge-like" character of the protein-starch matrix as illustrated in Figure
19 7. This structure provides channels for hot water to penetrate rapidly,
20 hydrate and cook the pasta.

1 For the pasta product of the present invention, control of density and
2 texture is directly linked to the control of the toasting conditions employed
3 and the moisture content of the pasta dough. It has been found that higher
4 toasting temperature in first and subsequent toasting zones increases pasta
5 porosity and decreases pasta density. For example, toasting at temperatures
6 from about 180°F up to about 325°F caused the pasta density to continue
7 to decrease. However, when the temperature was held at 325 °F or higher
8 for too long, an increase in pasta density was observed, indicating a partial
9 collapse in the protein starch matrix. These data are illustrated in Table I.
10 This collapse was apparently the result of overextending or stressing the
11 protein starch matrix.

TABLE I

14	15	16	17	18	19	20
	<u>Test #</u>	<u>Zone 1 °F</u>	<u>Zone 2 °F</u>	<u>Density</u>	<u>(g/cc)</u>	
	3	276	325	0.802		
	7	276	325	0.815		
	4	325	325	0.832		
	8	325	325	0.825		

1 According to the present invention, freshly mixed pasta dough at
2 a moisture content of from about 15% to about 35% moisture, preferably
3 from about 26% to about 33% moisture, is extruded or sheeted to form
4 the desired thin or thick walled pasta. The moist pasta is then cut to the
5 desired size and the pieces are processed by toasting at a temperature
6 from about 180°F to about 350°F for from about 1 to about 25 minutes.
7 The preferred processing temperature range is from about 210°F to
8 about 310°F for from about 2 to about 15 minutes to attain a moisture
9 content of less than about 13%, i.e., from about 2% to about 13%,
10 preferably from about 5% to about 12%. Toasting can be conducted in
11 more than one zone and a heating with steaming step can be used just
12 prior to the first toasting zone. When heating with steaming is used, the
13 temperature in that step must be at least 212°F to cause expansion of the
14 pasta and it can be as high as about 350°F. When there is no heating
15 with steaming step, the minimum temperature in the first (or only)
16 toasting zone also must be 212°F to cause expansion of the pasta.

17 In a preferred embodiment of the invention, toasting is conducted
18 in two or more toasting zones as mentioned above. Additionally, the
19 optional step of heating and steaming the pasta just prior to toasting can
20 be used further to partially cook the pasta and set the pasta surface. The
21 preferred toasting time and temperature is varied depending upon pasta

1 shape, thickness, and the texture desired. Thicker moist pasta will
2 require longer toasting times and/or higher temperatures.

3 The degree of expansion and resulting pasta product density can
4 be manipulated to deliver the desired texture, hydration and cook time.
5 A significant advantage of this invention is in the ability to control the
6 pasta thickness and the degree of porosity/density needed to obtain the
7 desired preparation time and texture. Product density is controlled so
8 that the product will have a density from about 0.600 to about 1.050
9 g/cc. The preferred range of density is generally from about 0.700 to
10 1.000 g/cc. In practice the preferred range of density is dependent on
11 the specific application for which the pasta will be used. Control of
12 product density is one of the distinguishing characteristics of this
13 invention. Furthermore, the density of the pasta produced by this
14 invention sets it apart from the higher density, more than about 1.3 g/cc,
15 of commercially available precooked pasta and conventionally produced
16 pasta.

17 Density determinations were made according to the invention
18 using silicone oil according to the following procedure. An 8 ounce jar
19 was preweighed on a top loading balance sensitive to 0.01 grams and
20 precalibrated for volume using Silicone Oil (Fisher Scientific Cat. No.
21 S159-500). 25.0 +/- 0.5 grams of pasta was accurately weighed into the

1 jar and enough Silicone Oil at 23°C temperature was added to just cover
2 the pasta. A thin metal spatula was used to stir the mass to release any
3 trapped air. Addition of Silicone Oil was resumed until the oil was
4 almost to the rim of the jar. A preweighed flat 4 and ½ inch square, 1/8
5 inch thick plastic plate containing 24, 1/16 inch holes and one center 1/4
6 inch hole within the area of the top of the jar was placed on top of the
7 jar. It was positioned so that the large hole in the center was close to the
8 center of the jar opening. Silicone Oil was again added with a pipette
9 into the center hole until all air was excluded from beneath the plate.

10 The density of the silicone oil at 23°C of 0.961 g/cc was divided
11 into the weight required to fill the empty jar to establish the jar volume
12 and separately into the weight of the oil added to fill the jar when it
13 contained the pasta, to establish the volume of the pasta by difference.
14 After the pasta weight was adjusted for its moisture content to obtain the
15 weight on a dry basis, the pasta weight was divided by the determined
16 pasta volume to obtain the pasta density.

17 Density control according to the invention is achieved by the
18 controlling the toasting time and temperature in the toasting zone, and
19 preferably in two or more separate toasting zones. Control of the
20 extrusion process (moisture content and vacuum level) and the toasting

1 process (toaster residence time and toasting temperature) will control the
2 product density.

3 In the first toasting zone, and to a lesser degree in any second and
4 subsequent zones, the pasta dough is pliable and has the greatest amount
5 of moisture available for conversion to steam for matrix expansion
6 within the pieces of pasta. It has been observed, however, that a very
7 high degree of matrix expansion (very low product density) can result in
8 fragile pasta with a soft texture and poor product integrity. On the other
9 hand, too little expansion (high product density) will decrease porosity,
10 increase preparation time requirements and reduce cooked yield. Some
11 cooking of the dough can also take place in the first toasting zone. After
12 the first and second toasting zones, subsequent toasting zones can be
13 utilized to further reduce moisture content.

14 Toasting temperatures in the toasting zones are kept in a range
15 from about 180°F to about 350°F with the preferred range being from
16 about 210°F to about 310°F.

17 Air velocity during toasting has been found to be important to
18 drying uniformity and product uniformity. Effective air velocities
19 employed are from about 150 to 800 feet per minute with the preferred
20 range being from about 250 to 800 feet per minute. Airflow velocities
21 are varied depending on the product shape, thickness and the desired

1 final moisture content of the pasta to attain desired product uniformity
2 and rate of moisture loss.

3 Following toasting, the toasted pasta is removed from the toaster
4 and cooled to ambient temperature by conventional means such as by
5 using a forced air cooler.
6

7 As noted above, the products of the invention are partially pre-
8 cooked, having a degree of gelatinization from about 15% to about 80%,
9 preferably from about 25% to about 75%. In order to determine the
10 degree of gelatinization of a pasta product, the total heat absorbed during
11 the gelatinization of a weighed portion of pasta in sufficient water is
12 measured by a differential scanning calorimeter (DSC).

13 To accomplish this, at least 10 grams of the product is finely
14 ground and 10 milligrams (mg) of this is weighed into the bottom
15 portion of a special stainless steel capsule which fits in the instrument.
16 The weighing is done on a microbalance accurate to at least 0.01 mg.
17 Twenty mg of water is then injected into the capsule bottom on top of
18 the pasta and the total weight of the capsule contents obtained. The lid
19 of the capsule, which is fitted with a neoprene "O" ring, is placed on the
20 capsule bottom as a cover. Pressure is applied to form a hermetic seal
21 which will prevent the loss of moisture during heating. The capsule is

1 placed in the sample well of the DSC instrument chamber and a sealed
2 empty capsule is placed in the reference well. The chamber is uniformly
3 heated at a constant rate and the difference in the heat absorbed by the
4 sample over the blank is determined in joules / gram for a peak in a
5 region of the resulting thermogram near 70° C. This result is subtracted
6 from the value similarly determined for a sample of the raw wheat
7 component (such as semolina or durum wheat) utilized in making the
8 product. Since the two values represent how much heat was required to
9 gelatinize the remaining ungelatinized starch present in the individual
10 samples, the difference expressed as a % is the level to which the
11 product has already been gelatinized.

12 The products of the invention also exhibit superior cooked yield
13 (sometimes referred to the art simply as yield or % hydration). In order
14 to determine cooked yield, optimum cook time must be measured and
15 this was done using the chewing method and the squeeze method for
16 each sample and using the results of the method that gave the shortest
17 cook time.

18 According to the chewing method, 25 grams of dry pasta is
19 cooked in a beaker containing 300 ml of boiling distilled water. A timer
20 is started and pieces of cooked pasta are removed from the cooking
21 water at 30 second intervals. The pieces are chewed through between

1 molar teeth. The optimum cook time is the time when no hard core is
2 detected for the first time.

3 According to the squeeze method, 25g of the same dry pasta
4 formulation is cooked in a beaker containing 300 ml of boiling distilled
5 water. A timer is started and pieces of cooked pasta are removed from
6 the cooking water at 30 second intervals and placed between two pieces
7 of clear plastic. The optimum cook time is the time when a white center
8 core of cooked pasta disappears for the first time. (See Method 16-50,
9 AACC in the 1995 Edition of Methods of the American Association of
10 Cereal Chemists, 3340 Pilot Knob Road, St. Paul, MN 55121 USA).

11 Cooked yield then is determined by adding 10 grams of the same
12 dry pasta formulation to 300 grams of boiling distilled water and
13 cooking for the optimum cook time as determined above. Then the
14 cooked pasta is drained on a sieve for 5 minutes and weighed. The
15 cooked yield of the pasta is reported as a percentage of the initial dry
16 pasta weight of 10 grams. The cooked yield of the pasta of the invention
17 is from about 315% to about 450%, preferably from about 330% to
18 about 425%.

19 Variations on the method of making the pasta product include the
20 use of steam prior to the toasting process to modify product attributes by
21 increasing product integrity, increasing resistance to "checking or

1 cracking", reducing starch loss, increasing pasta firmness and increasing
2 tolerance to over cooking. This can be achieved by introducing food
3 grade steam into the same apparatus that otherwise would be used for
4 toasting. Steam functions to precook starch and to denature protein on
5 the surface of the pasta products. This process modification
6 significantly strengthens the protein-starch matrix. The degree of starch
7 gelatinization and protein insolubility can be used as indicators of the
8 type and extent of processing, bearing in mind that the product of the
9 invention is not fully pre-cooked.

10 Steaming also increases our ability to design products with the
11 product attributes indicated. These attributes are especially important in
12 that they improve product performance in many convenience oriented
13 preparation methods such as microwave, boiling water pour-over, and
14 stove-top preparations.

15 Further improvements in preparation time can be achieved by the
16 addition of salt. The addition of up to about 3% salt based on the weight
17 of the farinaceous material (such as wheat, corn, soy flours, semolina,
18 farina and the like) also improves hydration by creating voids within the
19 structure of the pasta and noodles after the salt dissolves during cooking.
20 Highly soluble salts dissolve leaving fine trails or voids in the pasta
21 structure that facilitates water penetration during cooking. For example,

1 a 2% salt level improved preparation time during one microwave
2 application to 4 to 4.5 minutes when compared to a 5 minute microwave
3 preparation time without salt.

4 Manipulating the type, quality and quantity of protein in the
5 extruded dough modifies pasta product performance. The addition of
6 protein sources, such as vital wheat gluten, egg proteins, soy and other
7 food grade protein sources in amounts from about 0.25% to about 10%
8 can be used to modify the pasta product attributes, with the typical range
9 being from about 0.5% to 5.0%. Protein sources are especially useful
10 when farinaceous materials are utilized that are low in protein content or
11 in instances where the native protein functionality is lacking. Added
12 proteins can be used to modify texture, increase firmness, reduce starch
13 loss, improve tolerance to overcooking and maintain product integrity
14 during rigorous preparation procedures that require frequent stirring.

15 By controlling the dough moisture, toast conditions and
16 modifying the protein matrix it is possible to design the pasta product
17 texture and hydration characteristics to suit specific preparation
18 methods. Under the present invention, it is now possible to "design
19 pasta" that has the characteristics of reduced cooking time and to create
20 the desired pasta texture.

1 The method of the invention can be applied to any shape of pasta.
2 Pasta can be made in any short and long good shape and may be of
3 conventional or thin wall thickness. Wall thicknesses are chosen as a
4 function of the type of preparation method and preparation time
5 requirements needed.

6 In a preferred embodiment of the invention, a sauce is provided in
7 combination with the pasta and the bowl of the invention and a new
8 granular product is employed to make the sauce. With this embodiment
9 the consumer adds water, gently stirs, heats in a microwave oven to cook
10 and hydrate and then gently stirs again before eating. It is not necessary
11 to interrupt cooking to stir. The granular product tends not to form
12 clumps when water or milk is added and requires minimal stirring.

13 Sauces according to the invention can be made in a broad variety
14 of flavors and textures, as long as the principles of the invention are
15 followed as to processing conditions and the use of a second binder
16 which provides a granulated product having the desired hydrophobic
17 and hydrophilic characteristics. As described above, the desired
18 hydrophobic and hydrophilic characteristics means the granular product
19 does not tend to form clumps when water or milk at a temperature from
20 about 5°C up to about 100°C is added. Stirring is not required during
21 cooking and minimal stirring is required before and after cooking to

1 obtain a uniform homogenous sauce. In normal use, water or milk from
2 the refrigerator at a temperature from about 5°C to about 15°C or
3 ambient water at a temperature from about 15-30°C is employed and the
4 granular product does not tend to form clumps in this temperature range
5 from about 5° to about 30°C.

6 Granule size is important to achieve the objectives of the sauce of
7 the invention because too many fine particles causes clumps and too
8 many large particles increases the time required for hydration. A few
9 particles that are too big or too small can be tolerated, however, as long
10 as more than about 90%, preferably more than about 98%, have a
11 particle size in a range from about 1000 microns to about 175 microns.
12 This means that more than about 90%, preferably more than about 98%
13 of the particles, by weight, pass through a USS #18 mesh sieve and are
14 retained on a USS #80 mesh sieve.

15 Various ingredients can be used to make the granular product of
16 the invention depending upon the desired flavor and texture of the sauce
17 or soup to be prepared when the granules are hydrated. Some of these
18 ingredients may have their own hydrophilic or hydrophobic
19 characteristics and this can affect the composition of the second binder
20 and the amount of second binder required to obtain granules having the
21 desired characteristics. Accordingly, while an emulsifier is always

1 required as an ingredient of the second binder, the other ingredients can
2 be, for example, water if the granules do not need any additional
3 ingredients to impart hydrophobic characteristics. This easily can be
4 determined by one skilled in the art based on the guidance provided
5 herein and the known characteristics of ingredients of the granular
6 product. Small scale routine experiments can be conducted to optimize
7 the hydrophobic and hydrophilic characteristics of the granular product.

8 The granular product of the invention is made by first preparing a
9 dry mix of desired ingredients with from about 2% to about 55%,
10 preferably from about 18% to about 35%, fat or fat substitutes (the
11 percentages being based on total weight of the end product, i.e., the
12 granular product of the invention) or a combination thereof. Suitable
13 fats are commercially available, food grade, fat powders. The desired
14 ingredients can include crystalline ingredients such as sugar, salt, citric
15 acid and substitutes therefor; dairy ingredients such as dry milk, cheeses,
16 cream powders and the like; spices, natural and artificial flavors,
17 thickening agents such as starches (native, modified, waxy, etc.) and
18 vegetable gums and the like and any combination of the foregoing.

19 A mixing vessel such as a high shear or fluid bed mixer is used to
20 make a dry mixture by admixing the fat component with all of the
21 remaining ingredients except for the binders and heat sensitive

1 ingredients (i.e. natural and artificial flavors, spices and protein
2 compounds).

3 The dry mixture is heated to about the drop point of the fat
4 component, i.e. to the melting point or a temperature up to about 3°C
5 higher than the melting point, and then it is sprayed with a first binder
6 solution to make a first particulate composition.

7 Forming particulates with the first binder solution is
8 accomplished by spraying through a nozzle during mixing using
9 conventional vessels for this purpose such as a high shear mixer or a
10 fluidized bed mixer. Suitable high shear mixers include the continuous
11 Schugi mixers available from Hosokawa Bepex Corporation,
12 Minneapolis, Minnesota, USA and the Zanchetta mixer available from
13 Zanchetta & C.s.r.L., Lucca, Italy. Suitable fluidized bed mixers are the
14 Glatt fluidized bed available from Glatt Air Techniques, Inc., Ramsey,
15 New Jersey, USA and the Niro Aeromatic available from Niro
16 Aeromatic, Bochum, Germany. These vessels are known in the art and
17 described in the literature. For example, use of the fluidized bed for
18 granulating and drying is described in *FLAVOR ENCAPSULATION*,
19 Chapter 17 by Jones, David M., Controlling Particle Size and Release
20 Properties, pages 158-176, Copyright 1988, American Chemical

1 Society, Washington, D.C., ACS Symposium Series 370, edited by
2 Risch, Sara J. and Reineccius, Gary A.

3 The first binder is water or an aqueous solution which can contain
4 as ingredients from about 0% to about 35% of soluble starch (e.g., any
5 soluble modified food starch), 5-20 dextrose equivalent ("D.E.")
6 maltodextrin, dextrose, sugar (sucrose) or salt or any combination of two
7 or more of such ingredients.

8 The amount of the first binder composition employed, including
9 the water, is from about 1% to about 50%, preferably from about 10% to
10 about 30% by weight of first binder based on total weight of the
11 granular product of the invention.

12 As an example of the invention, when a fluidized bed is used to
13 spray the first binder on the dry mixture, the binder is sprayed through a
14 nozzle in the fluidized bed as the dry mixture is fluidized in the vessel.
15 The orifices in the nozzle are sized so that droplets of the desired size are
16 formed and this determines the particle size of the first particulate
17 composition. The temperature in the fluidized bed is maintained at from
18 about 20°C to about 50°C depending upon the melting point of the fat
19 component, the objective being to keep the temperature close to the drop
20 point to enhance binding.

1 The first particulate composition is dried to a moisture content of
2 from about 2% to about 6% at a temperature from about 35°C to about
3 60°C, preferably using fluidized drying or drying under a vacuum to
4 make a dried first particulate composition.

5 Using cool air or a cold jacketed mixer, the dried first particulate
6 composition is cooled to ambient temperature or from about 15°C to
7 about 40°C. Then the heat sensitive ingredients such as natural and
8 artificial flavors, spices and protein compounds are admixed with said
9 particulate composition. This is generally done in mixing vessel such as
10 a fluid bed or impeller/chopper for from about 1-3 minutes. Following
11 mixing, a second binder composition is coated on the particles by
12 spraying through a nozzle in a fluidized bed or a high shear mixer, in the
13 same manner as the application of the first binder composition.

14 The second binder composition is a solution comprised of two
15 components. The first component is comprised of a food grade oil
16 and/or a binder such as the first binder composition defined herein.
17 Suitable food grade oils are those having a low linolenic acid content
18 such as corn oil, cottonseed oil, peanut oil, olive oil and the like. Higher
19 linolenic acid oils such as soybean oil are not recommended because
20 they can become rancid quickly when they are sprayed. Suitable first
21 binder compositions are all of those identified herein and they can be the

1 same or different than the first binder composition used to prepare the
2 first particulate composition of the invention. The second component of
3 the second binder composition is a food grade emulsifier such as
4 lecithin, mono or diglycerides or combinations thereof. The ratio of the
5 first component to the second component is from about 1:0.25 to about
6 1:1 and the amount employed is from about 0.2% to about 2.5% based
7 on total weight of the end product (i.e., the granular product of the
8 invention). After the particulate composition has been coated with the
9 second binder, it is a granulated product ready for use to make a sauce or
10 a soup according to the invention. In some cases, if too many oversize
11 granules are produced, all of the product is sieved through a USS #10
12 sieve before use according to the invention. Further sieving may be
13 done, if necessary, but no sieving should be needed once the processing
14 conditions have been optimized.

15 When the product of the invention containing the sauce mix is
16 prepared for consumption by the consumer, water is added to the fill line
17 of the container. the contents are stirred gently and the product is placed
18 in a microwave oven to be cooked, generally for about 5 minutes.
19 During cooking, the product starts to boil after about 2.5 minutes. At the
20 time when the product reaches the boiling point, especially on the side
21 of the bowl, there is a sufficient amount of starch that leaches from the

1 pasta along with the fat and other compounds from the sauce mix to
2 form a thin liquid film which forms a foam. The foam in this case is a
3 dispersion that is a suspension and/or emulsion. This dispersion,
4 depending upon the contents of the product, may have varying particle
5 size and composition, and hence varying surface tension.

6 In this embodiment, where about 5 minutes cooking time is
7 needed to allow the pasta and the sauce to be cooked, it is desirable to
8 avoid foaming, splashing and boil over. Foam that forms during
9 cooking helps the product to cook properly because it effectively raises
10 the fluid level in the bowl to cover the pasta and cook it uniformly.
11 Without the foam, the pasta in the top of the bowl will not be cooked.
12 Accordingly, applicants needed to control the foam, minimize the
13 splashing and prevent the boil over so that stirring during cooking could
14 be eliminated for convenience purposes.

15 Applicants have discovered that the presence of surfactants such
16 as the mono & di glycerides employed in applicants' fat containing
17 sauce mixes cause less splashing/foaming while permitting sufficient
18 foaming to cook the product. Even though, the surfactants are
19 considered as foam stabilizers, in this application when they are used in
20 a small concentration they control the foaming process during cooking.
21 Mono & di glycerides are self-dispersible by virtue of the presence of

1 hydrophilic-lipophilic groups in the same molecule that can be highly
2 effective antifoam agents. The addition of lecithin as a wetting agent
3 and as a surfactant in this system also plays a role in controlling
4 foam/splashing and preventing boil over.

5 Of interest in this regard is U.S Patent No. 4,185,122. The patent
6 provides a method of preventing or eliminating the foaming of
7 polymeric dye-containing aqueous solutions, particularly soft drink
8 compositions, by use of glycerol monooleate, glycerol dioleate or a
9 mixture thereof. "Glycerol monooleate (GMO) and glycerol mono- and
10 dioleate (GMDO) are food grade additives usually considered to be
11 emulsifiers and solvents. They are described as effective at low
12 concentrations when used as defoamers for certain aqueous solutions.
13 This is distinguished from the present invention where foam/
14 splashing and boil over is controlled as discussed above.

15

16 **EXAMPLES**

17

18 **Example 1**

19 A disposable bowl was made by injection molding a blend of
20 polypropylene and high density polyethylene. The inside diameter at
21 the end opening was 110 mm and the inside diameter at the bottom of

1 the side panel (where the side panel 18 meets radius 17 in Fig. 3) in a
2 plane normal to the central axis was 95 mm. The interior height of the
3 bowl from the bottom panel to the end opening was 75 mm. The push-
4 up had an outside diameter (i.e., inside the bowl) of 45 mm and a height
5 from the lowest point inside the bottom of the bowl of 10 mm. The
6 bowl was filled with liquid to a fill line located 25 mm below the end
7 opening and subjected to microwave heating. The liquid boiled
8 vigorously without boiling over.

9

10 Example 2

11 A wheat flour dough mix made of 77% of semolina and 23% of
12 water was fed to a Demaco laboratory pasta press, fitted with a rotini die
13 and a cutting knife, which extruded formed pieces of fresh pasta (32%
14 moisture) with a pasta thickness of 0.027". Unlike the typical pasta
15 extrusion process, no vacuum was used during pasta extrusion. The
16 extruded pieces as formed were transferred to a forced air cooler fitted
17 with an air blower to remove the surface moisture of the freshly
18 extruded pasta and to prevent the pasta pieces from sticking together
19 during subsequent processing steps. The surface dried pasta was
20 transferred to a laboratory Proctor & Schwartz toaster (a "P&S" toaster
21 available from Proctor & Schwartz, 251 Gibraltar Road, Horsham, PA

1 19044 USA) and toasted at 298° F for 2.25 min. with an air velocity
2 setting of 250 ft/min. Then, the toasted pasta was removed from the
3 toaster and cooled to ambient temperature by using a forced air cooler.
4 Unlike typical dried pasta, the toasted pasta had an expanded internal
5 structure with many expanded air cells, which made the toasted pasta
6 cook faster than regular pasta while maintaining typical pasta texture
7 under regular cooking in boiling water and microwave cooking. The
8 density of the toasted pasta was 0.78 g/cc, degree of gelatinization was
9 59.3% and cooked yield was 348% at the optimum cook time of 3
10 minutes.

11

12 Example 3

13 The same dough formulation was extruded and air dried as in
14 Example 2. The surface dried pasta was transferred to a laboratory P&S
15 toaster and toasted at 260° F for 14 min. with an air velocity setting of
16 250 ft/min. Then, the toasted pasta was removed from the toaster and
17 cooled to ambient temperature by using the forced air cooler. Unlike
18 typical dried pasta, the toasted pasta had an expanded internal structure
19 with many expanded air cells, which made the toasted pasta cook faster
20 than regular pasta while retaining the texture of typical pasta under
21 various types of cooking conditions (regular cooking in boiling water

1 and microwave cooking). The density of the toasted pasta was 0.95
2 g/cc, degree of gelatinization was 24.1% and the cooked yield was 337%
3 at the optimum cook time of 4 minutes.

4 5 Example 4

6 The same dough formulation was extruded and air dried as in
7 Example 2. The surface dried pasta was transferred to a laboratory P&S
8 toaster and toasted at 285° F for 5 min. with an air velocity setting of
9 250 ft/min. Then, the toasted pasta was removed from the toaster and
10 cooled to ambient temperature by using the forced air cooler. Unlike
11 typical dried pasta, the toasted pasta had an expanded internal structure
12 with many expanded air cells, which made the toasted pasta cook faster
13 while retaining typical pasta texture under various types of cooking
14 conditions (regular cooking in boiling water and microwave cooking).
15 The density of the toasted pasta was 0.83 g/cc, degree of gelatinization
16 was 40.6% and cooked yield was 371% at the optimum cook time of 3.5
17 minutes.

18 19 Example 5

20 A wheat flour dough mix made of 76% of semolina, 23% of
21 water and 1% of table salt was fed to a Demaco laboratory pasta press,

1 fitted with a rotini die and a cutting knife, which extruded formed pieces
2 of fresh pasta (32% moisture) with a pasta thickness of 0.027". No
3 vacuum was used during pasta extrusion. The extruded pieces as formed
4 were transferred to a forced air cooler fitted with an air blower to
5 remove surface moisture of the freshly extruded pasta to prevent pasta
6 pieces from sticking together during subsequent processing steps. The
7 surface dried pasta was transferred to a laboratory P&S toaster and
8 toasted at 298° F for 2.25 min. with an air velocity setting of 250 ft/min.
9 Then, the toasted pasta was removed from toaster and cooled to ambient
10 temperature by using the forced air cooler. This product cooked even
11 faster because of the expanded internal structure and the presence of salt
12 which helps cooking water penetrate into the internal structure under
13 various types of cooking conditions (regular cooking in boiling water
14 and microwave cooking). The density of the toasted pasta was 0.81
15 g/cc, degree of gelatinization was 46.8% and cooked yield was 343% at
16 the optimum cook time of 2.25 minutes.

17

18 Example 6

19 A wheat flour dough mix made of 78% of semolina and 22% of
20 water was fed to a Buhler pasta press model TPAE. fitted with a rotini
21 pasta die and a cutting knife, which extruded formed pieces of fresh

1 pasta (31% moisture) with a pasta thickness of 0.027". No vacuum was
2 used during pasta extrusion. The extruded pasta as formed was
3 transferred pneumatically to a Buhler fluid bed toaster, model DNTW,
4 and was toasted at 277° F for 6 min. with an air velocity setting of 670
5 ft/min. Then, the toasted pasta was cooled to ambient temperature in the
6 cooling zone of the toaster. Unlike typical dried pasta, the toasted pasta
7 had an expanded internal structure with many small air cells, which
8 made the toasted pasta cook faster than regular pasta while maintaining a
9 typical pasta texture under various types of cooking conditions (regular
10 cooking in boiling water and microwave cooking). The density of the
11 toasted pasta was 0.83 g/cc, degree of gelatinization was 60.3% and
12 cooked yield was 377% at the optimum cook time of 2.5 minutes.

13

14 **Example 7**

15 The same pasta formulation as used in Example 6 was extruded
16 under the same conditions and transferred pneumatically to a Buhler
17 fluid bed toaster, model DNTW. The pasta was toasted at 327° F for 2
18 min. with an air velocity setting of 670 ft/min. for the 1st zone and at
19 277° F for 2 min with the same air velocity for the 2nd zone. Then, the
20 toasted pasta was cooled to ambient temperature in the cooling zone of
21 the toaster. Unlike typical dried pasta, the toasted pasta had an

1 expanded internal structure with many expanded air cells, which made
2 the toasted pasta cook faster than regular pasta while retaining typical
3 pasta texture under various types of cooking conditions (regular cooking
4 in boiling water and microwave cooking). The density of the toasted
5 pasta was 0.76 g/cc, degree of gelatinization was 71.2% and cooked
6 yield was 389% at the optimum cook time of 3 minutes.

7

8

1 **Example 8**

2 The same pasta formulation as used in Example 7 was extruded
3 under the same conditions and transferred pneumatically to a Buhler
4 fluid bed toaster, model DNTW, where the pasta was toasted at 212° F
5 for 4 min. with an air velocity setting of 670 ft/min. for the 1st zone and
6 at 284° F for 4 min. with the same air velocity for the 2nd zone. Then
7 the toasted pasta was cooled to ambient temperature in the cooling zone
8 of the toaster. Unlike typical dried pasta, the toasted pasta had an
9 expanded internal structure with small air cells, which made the toasted
10 pasta cook faster than regular pasta with typical pasta texture under
11 various types of cooking conditions (regular cooking in boiling water
12 and microwave cooking). The density of the toasted pasta was 0.99
13 g/cc, degree of gelatinization was 31.9% and cooked yield was 383% at
14 the optimum cook time of 3 minutes.

15 **Example 9**

16 The same dough formulation was extruded and air dried as in
17 Example 2. The surface dried pasta was transferred to a laboratory P&S
18 toaster conditioned with steam by injecting 15 lbs of steam into the
19 toaster. The pasta was heated at 298°F for 1.0 min with steam and then
20 toasted for 1.25 min without steam by disconnecting the steam line.
21 Then the toasted pasta was removed from the toaster and cooled to

1 ambient temperature by using the forced air cooler. This product had
2 the same expanded internal structure as toasted pasta that was not steam
3 treated but it had better structural integrity than toasted pasta that was
4 not steam treated. It also had the same textural and cook time
5 characteristics as the toasted pasta that was not steam treated. The
6 toasted pasta had a density of 0.95 g/cc, a degree of gelatinization of
7 56.5% and a cooked yield of 365% at the optimum cook time of 3
8 minutes.

9
10 Example 10

11 A wheat flour dough mix made of 73.6% of semolina, 23% of
12 water, 1.8% of wheat gluten and 1.6% of powered egg white was fed to
13 a Demaco laboratory pasta press, fitted with a rotini die and a cutting
14 knife, which extruded formed pieces of fresh pasta (32% moisture) with
15 a pasta thickness of 0.027". No vacuum was used during pasta extrusion.
16 The extruded pieces as formed were transferred to a forced air cooler
17 fitted with an air blower to remove surface moisture of the freshly
18 extruded pasta to prevent pasta pieces from sticking together during
19 subsequent processing steps. The surface dried pasta was transferred to
20 a laboratory P&S toaster and toasted at 298°F for 2.25 min with an air
21 velocity setting of 250 ft/min. The toasted pasta then was removed from

1 the toaster and cooled to ambient temperature by using the forced air
2 cooler. This product had the expanded internal structure observed in the
3 other toasted pastas of the invention but it required slightly longer cook
4 time than the toasted pastas with no added wheat gluten and egg white.
5 The product had firm textural bite characteristics and excellent structural
6 integrity. The toasted pasta had a density of 0.85 g/cc, a degree of
7 gelatinization of 61.4% and a cooked yield of 317% at the optimum
8 cook time of 4.5 minutes.

9

10 Example 11

11 A wheat flour dough mix made of 77% of semolina and 23% of
12 water was fed to a plant scale Buhler press, model TPR, fitted with a
13 rotini die and a cutting knife, which extruded formed pieces of fresh
14 pasta (32% moisture) with a pasta thickness of 0.027". No vacuum was
15 used during pasta extrusion. The extruded pasta as formed were
16 transferred to a production scale P&S belt type toaster with 3 heating
17 zones and 1 cooling zone by a shaker conveyor fitted with an air blower
18 to remove surface moisture of the freshly extruded pasta. Then the pasta

1 was toasted for 2 min. at 300°F for zone 1, for 2 min at 266°F for zone
2 2, for 2 min at 220°F for zone 3 and was cooled for 2 min with ambient
3 air. Unlike typical dried pasta, the toasted pasta had an expanded
4 internal structure with many expanded air cells, which made the toasted
5 pasta cook faster while retaining typical pasta texture under various
6 types of cooking conditions (regular cooking in boiling water and
7 microwave cooking). The toasted pasta had a density of 0.75 g/cc, a
8 degree of gelatinization of 68.2% and a cooked yield of 398% at the
9 optimum cook time of 3 minutes.

10

11 Comparative Example 1 - Pasta

12 A dough mix of 45% corn flour, 25% soy flour and 30% hard
13 wheat flour was dry blended in a Hobart mixer. Water was admixed
14 with the dry blend to make a dough having 35% water. A DeMaco
15 laboratory pasta press, fitted with a rotini die and a cutting knife, was
16 used to extrude pieces of fresh pasta. A vacuum of 17 inches Hg was
17 used during extrusion.

18

1 A first portion of the pasta was toasted at 225°F for 15 minutes
2 and a photomicrograph was taken of a section of one piece. This
3 photomicrograph is Figure 8.

4 A second portion of the pasta was toasted at 300°F for 3 minutes
5 and a photomicrograph was taken of a section of one piece. This
6 photomicrograph is Figure 9.

7 The pasta dough was well mixed but it had a lumpy texture. The
8 pasta product had poor structural integrity. It also had a soft mushy
9 texture when it was hydrated and a harsh bitter soy flavor.

10

11 Comparative Example 2 - Pasta

12 A sample of a commercially available thin-walled pasta product
13 that rehydrates quickly, Instant Pasta-Spirals from N.V. Establ. Joseph
14 Soubry S.A., Ardooisesteeweg 110, 8800 Roeselare, Belgium, was
15 prepared for SEM analysis as set forth above. A photomicrograph of the
16 sample is shown in Figure 10, illustrating the dense nature of the
17 product.

18

1 Comparing the photomicrographs of Figures 7-10, none of the
2 comparative products (Figures 8-10) exhibit the open internal porous
3 structure of the pasta of the present invention, Figure 7.

4

5 Examples 12-13

6 The following ingredients were employed to make sauces for
7 pasta and the amounts are expressed by weight in pounds.

8

1	Base		
2	<u>Ingredients</u>	<u>Example 12</u>	<u>Example 13</u>
3			
4	Fat Powder	26.120	27.070
5	Tomato Powder	0.000	0.000
6	Sugar	0.000	0.000
7	Starch (Melojel)	20.353	17.080
8	Maltrin M150	4.260	5.000
9	Salt	7.660	7.650
10	Wheat Flour (dried)	3.510	2.600
11	Mono and Di Glycerides	0.451	0.450
12	Flavoring Components	34.864	32.051
13			
14	<u>Heat Sensitive</u>		
15	<u>Ingredients</u>	2.782	8.099
16			
17	<u>TOTAL</u>	100.000	100.000
18			
19	First Binder	4.400	3.000
20	Second Binder	1.420	1.420

21

22 The fat powder employed was NDX 112-V available from Kerry

23 Food Ingredients, Beloit, Wisconsin, USA. The powder contains 75%

24 partially hydrogenated soybean oil, sodium and calcium caseinate and

25 mono and di glycerides.

26 The tomato powder was Hot Break or Cold Break tomato

27 powder, or a combination thereof, available from McCormick,

28 Baltimore, Maryland, USA.

29 The sugar was sucrose.

30 The starch was Melojel, a native corn starch available from

31 National Starch. Woodbridge, New Jersey, USA.

1 The dried wheat flour was an enzyme inactivated wheat flour
2 from Bestfoods, Heilbronn, Germany.

3 The mono and di glycerides was Atmos 150 from EDC
4 Chemicals, Humko Chemical Division, Witco Corp., Memphis,
5 Tennessee, USA.

6 The flavoring components were spice extracts, cheese powders
7 and the like which are not heat sensitive.

8 The heat sensitive ingredients were natural and artificial flavors
9 and spices.

10 The first binder was a 10% aqueous solution of Maltrin M150
11 and the amount shown is expressed on a dry basis.

12 The second binder was corn oil and lecithin in a 2:1 ratio.

13 A Glatt Powder Coater/Granulator/Dryer Model GPCG-60 (a 60
14 kilogram fluidized bed apparatus, hereinafter the "apparatus") was used
15 to produce 100 pound batches of each of the foregoing sauces.

16 The bowl of the apparatus was charged with the base ingredients
17 and blended for 2 minutes to make a dry blend. The temperature of the
18 dry blend was about 30-40°C.

19 The dry blend was fluidized and an aqueous solution of 10%
20 maltodextrin M150 (available from Grain Processing Corp., Muscatine,
21 Iowa, USA as Maltrin M150 and having a D.E. of 15) was sprayed

1 through the nozzle of the apparatus at a concentration of 3-4.5% dry
2 basis based on total weight of the end product to make a first particulate
3 composition. Atomization pressure at the nozzle was 2.5 - 3.0 Bar and
4 the granulation was continued for 20-35 minutes depending on the
5 formula, product composition and batch size, as would be apparent to
6 one skilled in the art. The nozzle employed was a 3.0 millimeter (mm)
7 orifice nozzle provided by Glatt. The temperature of the first particulate
8 composition was from 37°C - 40°C.

9 The first particulate composition was dried in the apparatus for 3
10 - 6 minutes to a maximum product temperature of 50°C and a moisture
11 content of 3.55 - 4.26%. The composition then was cooled to a
12 temperature of about 40°C using cool air in the apparatus.

13 The heat sensitive ingredients then were added to the bowl and
14 blended for 2 minutes. Cooling was continued to maintain the
15 temperature below about 40°C.

16 The particles were again fluidized and a solution of corn oil and
17 lecithin, in a ratio of 2:1 by weight, was sprayed through the nozzle at a
18 concentration of 1.36 - 1.47%. Atomization pressure was at 5.2 Bar for
19 1.5 - 2 minutes and the nozzle employed was a 1.8mm orifice nozzle
20 provided by Glatt. The discharged agglomerated product was at a
21 temperature from 31-38°C.

1 In a scaled-up process, a Glatt Powder Coater/Granulator/Dryer
2 Model GPCG-500 was used to produce 1,000 pound batches of the same
3 product. Granulation and blending times were sufficiently increased to
4 obtain the same granulation and blending characteristics as in the
5 smaller batch size process and more nozzles of the same size were
6 employed to handle the increased throughput. All of the processing
7 parameters were otherwise the same and the characteristics of the
8 products were the same.

9

1 Examples 14-15

2 As in Examples 12 and 13, the following ingredients were
 3 employed and they were processed under the same conditions to make a
 4 granular product.

5	Base		
6	<u>Ingredients</u>	<u>Example 14</u>	<u>Example 15</u>
7			
8	Fat Powder	33.370	24.950
9	Tomato Powder	0.000	0.000
10	Sugar	0.000	0.000
11	Starch (Melojel)	18.880	20.450
12	Maltrin M150	4.050	3.880
13	Salt	6.430	2.570
14	Wheat Flour (dried)	2.520	3.720
15	Mono and Di Glycerides	0.460	0.357
16	Flavoring Components	27.535	36.962
17			
18	<u>Heat Sensitive</u>		
19	<u>Ingredients</u>	6.755	7.111
20			
21	<u>TOTAL</u>	100.000	100.000
22			
23	First Binder	3.700	3.000
24	Second Binder	1.440	1.360

25
 26

Examples 16-17

As in Examples 12 and 13, the following ingredients were employed and they were processed under the same conditions to make a granular product.

<u>Base</u> <u>Ingredients</u>	<u>Example 16</u>	<u>Example 17</u>
Fat Powder	22.780	18.350
Tomato Powder	0.000	30.900
Sugar	0.000	5.410
Starch (Melojel)	28.060	11.590
Maltrin M150	3.510	8.130
Salt	5.570	8.890
Wheat Flour (dried)	5.100	1.930
Mono and Di Glycerides	0.510	0.154
Flavoring Components	21.730	9.300
<u>Heat Sensitive</u> <u>Ingredients</u>	12.740	5.346
<u>TOTAL</u>	100.000	100.000
First Binder	4.400	3.000
Second Binder	1.420	1.470

Examples 18-19

As in Examples 12 and 13, the following ingredients were employed and they were processed under the same conditions to make a granular product.

1	Base		
2	<u>Ingredients</u>	<u>Example 18</u>	<u>Example 19</u>
3			
4	Fat Powder	17.761	16.727
5	Tomato Powder	29.913	16.727
6	Sugar	5.240	4.460
7	Starch (Melojel)	11.220	16.850
8	Maltrin M150	10.430	7.190
9	Salt	8.230	7.430
10	Wheat Flour (dried)	1.870	2.620
11	Mono and Di Glycerides	0.150	0.000
12	Flavoring Components	9.034	9.755
13			
14	<u>Heat Sensitive</u>		
15	<u>Ingredients</u>	6.152	18.241
16			
17	<u>TOTAL</u>	100.000	100.000
18			
19	First Binder	3.000	3.600
20	Second Binder	1.420	1.420

ANALYTICAL RESULTS

24 The granular products of Examples 12-17 and 19 were analyzed
 25 to determine various characteristics. A Powder Characteristics Tester
 26 available from Hasokawa Micron Division, 10 Chatham Road, Summit,
 27 New Jersey 07901 USA was used to test Bulk Density, Angle of Repose
 28 and Compressibility and other tests were conducted with other
 29 conventional laboratory instruments. The results were as follows:

30

1		<u>Example 12</u>	<u>Example 13</u>
2	Flavor	Cheese-1	Cheese-2
3	<u>Bulk Density</u>		
4			
5	Aerated g/cc	0.42	0.39
6	Packed g/cc	0.51	0.49
7	Dynamic g/cc	0.44	0.41
8			
9	Angle of Repose	41.00	40.00
10	Compressibility (%)	17.60	20.40
11	% Moisture	3.93	4.05
12	% Salt	8.	10.093
13	Aw (water activity)	0.348	0.319
14			
15	Granulation		
16	(% on USS#)		
17	18	23.00	8.40
18	35	56.80	47.40
19	60	18.20	37.00
20	80	1.40	5.60
21	120	0.00	1.60
22	170	0.00	0.00
23	Pan	0.00	0.00
24	Mechanical Stability	99.40	100.00
25			
26			
27			
28			

	<u>Example 14</u>	<u>Example 15</u>
1		
2		
3	Flavor	Cheese-3
4		Chicken-1
5	<u>Bulk Density</u>	
6		
7	Aerated g/cc	0.40
8	Packed g/cc	0.52
9	Dynamic g/cc	0.43
10		
11	Angle of Repose	44.00
12	Compressibility (%)	39.00
13	% Moisture	22.00
14	% Salt	3.55
15	Aw (water activity)	8.53
16		10.016
17		0.328
18	Granulation	
19	(% on USS#)	
20	18	17.00
21	35	2.60
22	60	52.40
23	80	48.20
24	120	23.80
25	170	34.20
26	Pan	5.20
27	Mechanical Stability	4.80
28		0.40
29		0.00

		<u>Example 16</u>	<u>Example 17</u>
1			
2			
3	Flavor	Chicken-2	Tomato
4			
5	<u>Bulk Density</u>		
6			
7	Aerated g/cc	0.40	0.42
8	Packed g/cc	0.53	.54
9	Dynamic g/cc	0.43	0.45
10	Angle of Repose	39.00	42.00
11	Compressibility (%)	24.50	22.20
12	% Moisture	3.96	4.06
13	% Salt	13.091	10.616
14	Aw (water activity)	0.279	0.327
15			
16	Granulation		
17	(% on USS#)		
18	18	5.20	3.20
19	35	33.80	49.40
20	60	52.80	42.80
21	80	7.00	4.20
22	120	0.20	0.00
23	170	0.00	0.00
24	Pan	0.00	0.00
25	Mechanical Stability	99.00	100.00
26			
27			
28			

Example 19

1		
2		
3	Flavor	Cheese-Tomato
4		
5	<u>Bulk Density</u>	
6		
7	Aerated g/cc	0.41
8	Packed g/cc	0.52
9	Dynamic g/cc	0.43
10		
11	Angle of Repose	43.00
12	Compressibility (%)	21.10
13	% Moisture	4.09
14	% Salt	10.325
15	Aw (water activity)	0.319
16		
17	Granulation	
18	(% on USS#)	
19	18	5.40
20	35	55.40
21	60	33.60
22	80	5.40
23	120	0.20
24	170	0.00
25	Pan	0.00
26	Mechanical Stability	100.00
27		

Example 20

Sixty grams of wet toasted pasta made by the processes described in Example 11 and 30g of sauce mix made by the processes described in Example 14 were put in the disposable bowl container described in Example 1. Then, 245g of cold water was added to the container and stirred moderately. The product was cooked in a 700 watt microwave oven for 5 minutes at high power and then stirred gently. The resulting product had optimally cooked pasta with al dente texture and optimal sauce consistency for a hot snack product. No boil over was noticed during microwave cooking preparation.



Patent Application Entitled:
"MICROWAVABLE PASTA IN A BOWL"

Claims in Counterpart Applications

1. A convenience food product comprising a container that provides improved cooking properties in a microwave oven and, disposed in the container, at least a single serving of a quick cooking, partially pre-cooked pasta product having a density from about 0.6 to about 1.05 g/cc and a degree of gelatinization from about 15% to about 80%.
2. The product of claim 1 wherein the pasta has a moisture content of less than about 13%.
3. The product of claim 2 wherein the pasta comprises a wheat flour dough.
4. The product of claim 1 further comprising a hydratable granular food composition comprised of granules having from about 2% to about 55% of a fat component, a binder coated thereon comprising an emulsifier, a size distribution wherein more than about 90% of the granules have a size from about 1000 microns to about 175 microns, the granules having hydrophobic and hydrophilic characteristics whereby the granules do not tend to form clumps when cold or ambient water or milk is added.
5. The product of claim 4 wherein the emulsifier is present in an amount from about 0.04% to about 2.5%.



6. The product of claim 4 wherein the cold or ambient water or milk is at a temperature from about 5°C to about 30°C.
7. The product of claim 4 further comprising compositions selected from the group consisting of crystalline ingredients, dairy ingredients, spices, natural flavors, artificial flavors and thickening agents.
8. The product of claim 4 wherein said binder coated thereon further comprises a composition selected from the group consisting of oil, water or an aqueous solution of from 0% to about 35% of a composition selected from the group consisting of starch, 5-20 D.E. maltodextrin, dextrose, sucrose and salt.
9. The product of claim 4 further comprising heat sensitive ingredients selected from the group consisting of natural flavors, artificial flavors, spices and protein compounds.
10. A method of hydrating the product of claim 4 comprising adding water or milk at a temperature from about 5°C to about 30°C and then heating.
11. The hydrated product of claim 10.
12. A convenience food product comprising a container that provides improved cooking properties in a microwave oven and, disposed in the container, at least a single serving of a quick cooking, partially pre-cooked pasta product having a cooked yield from about 315% to about 450% and a degree of gelatinization from about 15% to about 80%.
13. The product of claim 12 wherein the pasta has a moisture content of less than about 13%.
14. The product of claim 13 wherein the pasta comprises a wheat flour dough.



15. The product of claim 13 wherein the pasta consists essentially of a wheat flour dough.

16. The product of claim 12 wherein the container has a bottom portion, a side panel extending from said bottom portion and a cover receiving lip structure extending about and defining an end opening opposite the bottom portion, said side panel extending about a central axis through the bottom portion and end opening and comprising:

a bottom portion having a central segment and an outer segment, a substantially spherical section defining the central segment and having an apex on the central axis, the apex being disposed toward the end opening; said substantially spherical section having a substantially circular base intersecting a plane extending normal to the central axis, the outer segment having a base portion extending downward from said substantially circular base and away from the end opening along a first bottom radius and in a direction away from the central axis to a bottom panel, said bottom panel being substantially circular and extending away from the central axis along a plane extending substantially normal to the central axis to a second bottom radius and then extending upwardly along said second bottom radius away from said bottom portion and toward the end opening to the side panel;

said side panel having an exterior and having a continuous inner wall face intersecting a plane extending normal to the central axis along a substantially circular line and having a larger radius at the end opening than at the bottom portion whereby the inner wall face is tapered away from the central



axis as the side panel extends upwardly from the bottom portion toward the end opening.

17. The product of claim 16 wherein the outer segment further comprises a frusto-conical portion disposed between the second bottom radius and the side panel, said second bottom radius extending to the frusto-conical portion and said frusto-conical portion extending upwardly and tapering away from the central axis to a third bottom radius, the third bottom radius extending upwardly to the side panel.