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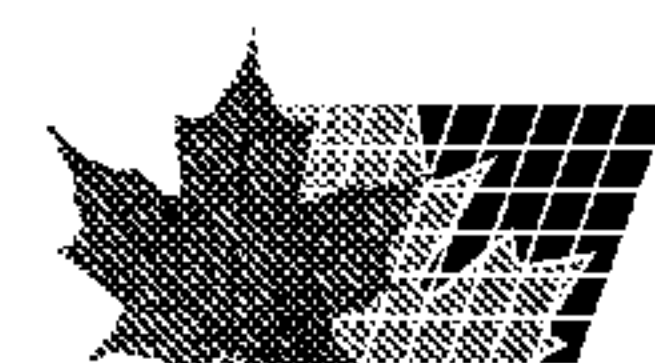
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(54) Titre : PRODUITS DE CONFISERIE A TENEUR REDUITE EN MATIERES GRASSES ET PROCEDE DE
FABRICATION DE CES PRODUITS

(54) Title: REDUCED FAT CONFECTIONERY PRODUCTS AND PROCESS

(57) **Abrégé/Abstract:**

The present invention relates to a lowfat confection comprising a chocolate of full fat texture, said chocolate comprising a fat or fat substitute present in 20.0-24.5 % (w/w), and nonfat solids comprising nutritive carbohydrate sweetener, nonfat cocoa solids and an edible emulsifier. The present invention further relates to a process for producing a lowfat chocolate and more specifically, to the process of preparing and formulating said product compositions.





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(54) Title: REDUCED FAT CONFECTIONERY PRODUCTS AND PROCESS (57) Abstract The present invention relates to a lowfat confection comprising a chocolate of full fat texture, said chocolate comprising a fat or fat substitute present in 20.0-24.5 % (w/w), and nonfat solids comprising nutritive carbohydrate sweetener, nonfat cocoa solids and an edible emulsifier. The present invention further relates to a process for producing a lowfat chocolate and more specifically, to the process of preparing and formulating said product compositions.		

1 REDUCED FAT CONFECTIONERY PRODUCTS AND PROCESS

 This invention relates generally to food product
compositions, and more particularly to confectionery
products, especially chocolate and chocolate-type
5 products containing a nutritive carbohydrate sweetener,
a fat or reduced calorie fat or combination thereof, and
an edible emulsifier or surfactant, wherein the fat
content is 20-24.5% by weight. In addition to the
lowfat content, the food products of the present
10 invention have rheology characteristics which are fully
acceptable for moulding, enrobing and extruding
operations. The present invention also relates
generally to a process for producing a lowfat chocolate
and more specifically, to the process of preparing and
15 formulating said product compositions, e.g.,
confectionery products, especially chocolate and
chocolate-type products having fat or reduced calorie
fat content or combination thereof, in which the total
fat or reduced calorie fat content can be as low as 20%.

20 Food products made from ingredients including a
carbohydrate sweetener such as sucrose and an edible oil
or fat such as cocoa butter are well known. An
important group of these food products is comprised of
confections, including candy.

25 The most popular chocolate or chocolate candy
consumed in the United States is in the form of sweet
chocolate or milk chocolate. Milk chocolate is a
confection which contains nonfat milk solids, milkfat,
chocolate liquor, a nutritive carbohydrate sweetener,
cocoa butter and may include other optional ingredients
30 such as emulsifiers and flavorings and other additives.

1 Sweet chocolate differs from milk chocolate in that it
requires more chocolate liquor and limits the amount of
milk solids. Semisweet chocolate requires at least 35%
by weight chocolate liquor and is otherwise similar in
5 definition to sweet chocolate. Commonly known dark
chocolate, generally containing only chocolate liquor, a
nutritive carbohydrate sweetener and cocoa butter, is by
definition either a sweet chocolate or a semisweet
chocolate. Buttermilk chocolate and skim milk chocolate
10 differ from milk chocolate in that the milk fat comes
from various forms of sweet cream buttermilk and skim
milk, respectively, and in the case of skim milk, the
total amount of milkfat is limited to less than the
minimum for milk chocolate. Mixed dairy product
15 chocolates differ from milk chocolate in that the milk
solid includes any or all of the milk solids listed for
milk chocolate, buttermilk chocolate or skim milk
chocolate. White chocolate differs from milk chocolate
in that it contains no non-fat cocoa solids. As used
20 herein, the term "chocolate" denotes chocolate, baking
chocolate, milk chocolate, sweet chocolate, semisweet
chocolate, buttermilk chocolate, skim milk chocolate,
mixed dairy product chocolate, white chocolate and non-
standardized chocolates, unless specifically identified
25 otherwise.

Chocolate used in foods in the United States is
subject to a standard of identity established by the
U.S. Food and Drug Administration (FDA) under the
Federal Food, Drug and Cosmetic Act. The U.S.
30 definitions and standards for the various types of
chocolate are well established. Nonstandardized

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1 chocolates are those chocolates which have compositions
which fall outside the specified ranges of the
standardized chocolates.

Examples of nonstandardized chocolates result
5 when the cocoa butter or milkfat are replaced partially
or completely; or when the nutritive carbohydrate
sweetener is replaced partially or completely; or
flavors imitating milk, butter or chocolate are added or
other additions or deletions in formula are made outside
10 the USFDA standards of identify of chocolate or
combinations thereof.

As a confection, chocolate can take the form of
solid pieces of chocolate, such as bars or novelty
shapes, and can also be incorporated as a component of
15 other, more complex confections where chocolate is
combined with and generally coats other foods such as
caramel, nougat, fruit pieces, nuts, wafers or the like.
These foods are characterized as microbiologically
shelf-stable at 65-85°F under normal atmospheric
20 conditions. Other complex confections result from
surrounding with chocolate soft inclusions such as
cordial cherries or peanut butter. Other complex
confections result from coating ice cream or other
frozen or refrigerated desserts with chocolate.
25 Generally chocolate used to coat or surround foods must
be more fluid than chocolates used for plain chocolate
solid bars or novelty shapes.

The process of coating chocolate onto a food is
known as enrobing. Enrobing is accomplished when the
30 chocolate is in a fluid state and a proper viscosity

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1 must be maintained in order to produce a satisfactory
coated product.

Chocolate can also be moulded. By moulding, it
is meant that chocolate, either plain or mixed with
5 nuts, raisins, crisped rice and the like is deposited in
moulds, allowed to cool and hardened into solid pieces
and then removed from the mould. Chocolate moulded into
plain chocolate pieces generally can be somewhat more
viscous than coating chocolates since the chocolate can
10 be vibrated into a mould over a longer period of time
than allowed in enrobing. However, chocolate moulded
with food inclusions generally must be as fluid as
coating chocolates.

Some novelty shapes made of plain chocolate are
15 extruded onto a cold belt such as Kisses® or chocolate
chips. Because the chocolate is extruded onto a cold
belt, it must be more viscous than for moulded plain
chocolate. Extruded chocolates are essentially extruded
to a particular shape and require a yield value to
20 retain the extruded shape while the chocolate hardens.

As noted above, the rheological characteristics,
i.e., the flow properties, of chocolate are very
important. Chocolate is non-Newtonian in nature. That
is, it flows differently depending upon how the
25 chocolate is stirred or pumped or how quickly it is
poured. These characteristics are described by two
measurements: a yield value, which relates to how much
force one must use to start the chocolate flowing; and a
plastic viscosity, which approximates the work done to
30 keep the chocolate flowing uniformly. If either the
yield value or the plastic viscosity is not within

1 certain prescribed limits, poor processing will result.
J. Chevalley, J. Texture Studies, 6: 177-196 "Rheology
of Chocolate" (1975) reported typical Casson yield
values and Casson plastic viscosities for commercial
5 coating chocolates of 0-200 dyn/cm² and 5-25 poise,
respectively, and for commercial moulding chocolates of
100-2000 dyn/cm² and 10-200 poise, respectively. These
values were confirmed some thirteen years later by J.
Chevalley, Industrial Chocolate Manufacture and Use,
10 Blackie & Son Ltd. Glasgow and London by AVI (1988).

The process of making chocolate is reviewed
generally in B.L. Zoumas and E.J. Finnegan, "Chocolate
and Cocoa", Kirk-Othmer Encyclopedia of Chemical
Technology, Vol. 6 (3rd Ed., Wiley-Interscience, New
York) 1-19 (1985). Processes for producing chocolate
15 can be either "wet" or "dry". In the "wet" process,
sweetened condensed milk is codried with chocolate
liquor to generate a crumb that is microbiologically
stable. In the "dry" process, milk powder is utilized
rather than condensed milk. As such, the ingredients as
20 received are microbiologically stable.

The "dry" process of making chocolate consists
essentially of the steps of mixing, refining, conching
or liquefying, standardizing and tempering to generate
the desired rheology as needed for enrobing, moulding or
25 producing novelty shapes.

In the first step in the preparation of milk
chocolate, a nutritive carbohydrate sweetener such as
extra fine grade granulated sucrose is combined and
mixed with cocoa butter, chocolate liquor and spray
30 dried whole milk powder. The resulting mixture is a

1 paste. Next, in the refining step, essentially a fine
grinding operation, the coarse paste from the mixer is
passed between steel rollers and converted to a refined
flake. Refining breaks up crystalline sugar, fibrous
5 cocoa matter and milk solids such that the sizes of the
particles are significantly reduced. This particle size
reduction results in the desired smoothness of the
chocolate. Fine chocolates usually have no particles
larger than 20 or 25 microns. This is usually
10 accomplished by passing the mixture through a plurality
of refining rolls.

In the conching step, the mixture is then stirred
while heating to give the final desired consistency to
the milk chocolate. This mixing-kneading process allows
15 moisture and volatile components to escape while
smoothing the chocolate paste and is critical to the
flavor and texture development of the chocolate.

Alternatively to the conching step, the
liquefying step mixes refined flake under high shear
20 over a short period of time. The refined flake is
quickly converted to a suspension of solids in a
continuous fat phase. The lack of flavor development
can be corrected by pretreating the liquor and cocoa
butter.

25 Additional fat and emulsifier are then added in
the standardizing or finishing step to adjust viscosity
to final specifications.

The final step in obtaining the desired rheology
of the chocolate is tempering, a process of inducing
30 satisfactory crystal nucleation of the liquid fat in the
chocolate. If the chocolate is improperly cooled, the

1 resulting chocolate will have a grainy texture as well
as poor color and appearance.

Finished chocolate is a suspension of very fine
particles (usually less than 50 microns) in fat. The
5 particles usually consist of cocoa solids and
crystalline sucrose as well as milk solids in the case
of milk chocolate. The cocoa solids in the chocolate
liquor and the milk solids have normally been processed
so they are fine enough to be incorporated into a
10 chocolate mixture. Sucrose, however, requires
considerable size reduction since extra fine grade
sucrose, for example, typically varies in crystal size
from about 40 to 1000 microns. To satisfactorily
function as an ingredient in chocolate, therefore, these
15 sucrose crystals should be reduced in size to less than
about 50 microns. Similar considerations apply in the
processing of other types of confections. It is known
that at least about 50% of the surface area of particles
in milk chocolate is produced by the presence of
20 particles below two microns in size. The presence of
these ultrafine particles increases viscosity and
increasing amounts of fat, e.g., cocoa butter, are
required to coat such particles in order for the
chocolate to flow properly in manufacturing operations.

25 Of particular concern in today's market is the
fat content of a product. The amount of total fat in
chocolates may vary somewhat depending on the
formulation and process involved. In recent years, in
view of this concern, there has been a steady reduction
in the total fat contents of all chocolate. See B.
30 Minifie, Chocolate, Cocoa, and Confectionery-Science and

1 Technology, 3rd Edition, Van Nostrand Reinhold, New York
(1989) p. 205. In fact, as Minifie reports, "good-
quality finely ground chocolates with total fat contents
down to 28% can now be produced and satisfactorily
5 moulded. Lower quality chocolates with coarser particle
size can be produced down to 25%. Particularly with
milk chocolate, quality suffers with fat contents below
30%, the texture becoming pasty with a lack of snap."

L.R. Cook, Chocolate Production and Use, Books
10 for Industry, Inc., New York (1975) p. 214, reports that
in order to maintain the proper rheological properties,
chocolate requires a minimum amount of total fat from 29
to 32% by weight. It was commonly believed by the
skilled artisan that if the fat level was below said
15 range, quality defects such as mealy, dry or powdery
texture, and excessive coating permeability leading to
dry centers would result. S.T. Beckett, PMCA Research
Notes 16 (1):1-2 (April 1992) reported the production of
cake chocolate with a fat content as low as 25% but
20 acknowledged the same was extremely "thick".

It is thus well known in the art that the amount
of fat present in chocolate will affect the flow
properties of the chocolate, i.e., the addition of fat
to a chocolate decreases both the yield value and the
25 plastic viscosity. Consequently, fat content must
therefore be varied according to the intended use. For
example, proper fat content for moulding chocolate was
reported at 30-34% and 35-40% for covering chocolate by
Lees and Jackson, Sugar Confectionery and Chocolate
30 Manufacture, Chemical Publishing Co., Inc., New York
(1975) pg. 124.

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1 When the fat content of chocolate is reduced,
other parameters must be affected in order to maintain
the proper rheological properties of the chocolate. The
presence of fat in chocolate is important in that the
5 fat covers the surface of all the solid particles.
Uncoated surfaces would cause rubbing between the
particles and reduce the flow.

Chocolates contain a very large amount of small
sugar particles. Fat does not cover the surface of the
10 sugar particles very easily and consequently, anything
which will form an interface between the sugar and fat
will aid in the flow of the chocolate. Surfactants,
e.g., emulsifiers, can produce such an interface by
coating the surface of the solid particles, in
15 particular, the sugar. As used herein, the term
"surfactant" means any compound that reduces surface
tension between a liquid and a solid in solution.

Emulsifiers or surfactants such as lecithin are
extremely effective in improving the flow properties of
20 chocolate, and are widely used for their commercial
benefit as a partial cocoa butter replacer. It has been
reported that the addition of 0.1-0.3% soya lecithin
reduces the viscosity by more than 10 times its own
weight of cocoa butter. Numerous other emulsifiers have
25 been found to have similar effects as lecithin in
lowering the yield value and plastic viscosity.
Emulsifier use has generally been limited to less than
1% of the chocolate formulation due to problems such as
off-flavors, legal controls, or negative rheological
30 effects at high levels. Since full-fat chocolates at
29-33% total fat typically contain 0.1-0.5% soya

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1 lecithin, significantly lower fat levels cannot be
achieved by altering the type/level of emulsifier.

Particle size of ingredients is also known to
influence the viscosity of chocolate. As the particle
5 size decreases, the viscosity increases as a general
rule. An excess of fine particles below 5 microns
whether derived from the sugar, milk, or chocolate
liquor/powder component, will make the chocolate
extremely thick and difficult to manage during pumping,
10 depositing, and enrobing operations. Coarse particles
will tend, however, to give the chocolate a gritty sandy
texture which is unacceptable to consumers should the
particle size exceed 60 microns.

Additionally, it is also well known within the
15 chocolate industry that moisture content has a
significant effect on the flow properties of chocolate.
If water is added to chocolate, a marked increase in
viscosity occurs. It has been previously reported that
both the yield value and plastic viscosity increase with
20 moisture levels above 1.1%. Between 0.6-1.1% moisture,
the plastic viscosity is nearly constant whereas the
yield value rises with increasing moisture. This could
be explained by the formation of layers of syrup on the
surface of sugar particles with an increase in moisture,
25 which increases the friction between the said particles.

In order to produce a reduced fat chocolate with
acceptable flow properties, it is essential to keep the
moisture content low. Conching for extended periods of
time (longer than 4 hrs.) at elevated temperatures
30 (above 100°F) is well known to be an effective method
for removing water from chocolate paste. The initial

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1 ingredients should be selected to have low moisture, and
chocolate processing should be done so that moisture
uptake from the atmosphere by hygroscopic ingredients is
kept to a minimum.

5 A review of 37 different branded chocolates made
by chocolate manufacturers in Europe, Asia or the
Americas indicates a range of fat for predominantly milk
chocolate from 27.5% to 45.1% by weight fat with an
average fat content of 32.7% by weight. Additionally,
10 three branded nonstandardized chocolates manufactured
either in Europe or the U.S. were observed with 25.4-
26.0% fat. Four branded European dietary chocolates,
whereby a sugar alcohol such as mannitol or sorbitol
substituted for a nutritive carbohydrate such as
15 sucrose, were by analysis observed to contain from 37.9%
to 45.0% fat. Further, analysis of the coating
chocolate used in the first 25% less calorie composite
bar marketed in the U.S. revealed a coating with 28% fat
content. However, to date, despite efforts in the
20 industry, no one has been able to produce a chocolate
consisting of less than 25% total fat having flow
properties suitable for moulding, extruding or enrobing
operations.

The present invention relates to a lowfat
25 chocolate of full-fat texture comprising a fat and
nonfat solids comprising nutritive carbohydrate
sweetener, and an edible emulsifier, said chocolate
containing 20-24.5% fat.

Also, the present invention relates to an edible
30 food product containing chocolate having the taste and
texture attributes of a normal fat content with far less

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1 fat. Thus, the chocolate of the present invention is
suitable for use in such products as confectioneries,
(e.g., candy bars), baking chocolate, chocolate chips,
ice cream bars, refrigerated desserts or other foods in
5 which chocolate is an ingredient. In these foods, the
chocolate has the rheological flow properties associated
with normal fat content chocolate but with far less fat.
The total fat content of chocolate compositions of the
present invention is 20 to 24.5% by weight. The
10 chocolate of the present invention contains non-fat
solids which comprise nutritive carbohydrate sweeteners
or sugar substitute, and an edible emulsifier.

The present invention further relates to methods
of producing various types of chocolate, e.g.,
15 confectionery items, with a reduced total fat content
which still has taste, texture, and flow properties
similar to normal full-fat confectionery products. In
the preferred products of the present invention, the
total fat content is as low as 20% wt. In the present
20 process, nutritive carbohydrate sweetener is mixed with
a fat or reduced calorie fat or combination thereof.
The mixture is refined to reduce the particle size. A
surfactant is added to the mixture in the presence of
water, and the mixture is dried under agitation and
25 heated until the desired consistency with the desired
fat content is obtained.

In the accompanying drawings, Figure 1 represents
a flow diagram of the modified process of refining the
nutritive carbohydrate sweetener (e.g., saccharide)
30 crystals of the present invention.

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1 Figures 2 and 3 illustrate variations on the
process for making a lowfat chocolate in accordance with
the present invention.

 Figures 4 and 5 illustrate variations on the
5 process for making a low fat/low calorie chocolate in
accordance with the present invention.

 The present invention relates to a chocolate or
chocolate-like food product in which the fat content is
20-24.5% by weight. The chocolate product contains a
10 nutritive carbohydrate sweetener, a fat or reduced
calorie fat or combination thereof and an edible
emulsifier or surfactant.

 In an alternative embodiment of the present
invention, a sugar substitute may partially replace the
15 nutritive carbohydrate sweetener. As used herein, the
term "sugar substitute" includes bulking agents, sugar
alcohols (polyols), or high potency sweeteners or
combinations thereof.

 The high potency sweeteners include aspartame,
20 cyclamates, saccharin, acesulfame, neohesperidin
dihydrochalcone, sucralose, alitame, stevia sweeteners,
glycyrrhizin, thaumatin and the like and mixtures
thereof. The preferred high potency sweeteners are
aspartame, cyclamates, saccharin, and acesulfame-K.

25 Examples of sugar alcohols may be any of those
typically used in the art and include sorbitol,
mannitol, xylitol, maltitol, isomalt, lactitol and the
like.

 Bulking agents as defined herein may be any of
30 those typically used in the art and include

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polydextrose, cellulose and its derivatives, maltodextrin, gum arabic, and the like.

Fats, as used herein, refer to triglycerides, diglycerides and monoglycerides that can normally be used in chocolates. Fats include the naturally occurring fats and oils such as cocoa butter, pressed cocoa butter, expeller cocoa butter, solvent extracted cocoa butter, refined cocoa butter and the like..

Reduced calorie fat, as used herein, is a fat
10 having all the properties of typical fat but exhibiting less calories than typical fat. An example of a reduced calorie fat is Caprenin as described in U.S. Patent No. 4,888,196 to Ehrman. et al.

The chocolate or chocolate type products of the present invention contain emulsifiers. Examples of safe and suitable emulsifiers may be any of those typically used in the art and include lecithin derived from vegetable sources such as soybean, safflower, corn,
20 etc., fractionated lecithins enriched in either phosphatidyl choline or phosphatidyl ethanolamine or both, mono- and diglycerides, diacetyl tartaric acid esters of mono- and diglycerides, monosodium phosphate derivatives of mono- and diglycerides of edible fats or oils, sorbitan monostearate, polyoxyethylene sorbitan monostearate, hydroxylated lecithin, lactylated fatty acid esters of glycerol and propylene glycol, polyglycerol esters of fatty acids, propylene glycol mono- and diester of fats and fatty acids or any
30 emulsifier that may become approved for the USFDA-defined soft candy category. In addition, other

1 emulsifiers that can be used in the present invention,
include polyglycerol polyricinoleate, ammonium salts of
phosphatidic acid, sucrose esters, oat extract, etc.,
any emulsifier found to be suitable in chocolate or
5 similar fat/solid system or any blend provided the total
amount of emulsifier does not exceed 1% by weight.

Emulsifiers preferred for use in the present invention
are lecithin, fractionated lecithin, diacetyl tartaric
acid esters of mono- and diglycerides (DATEM) or
10 mixtures of these emulsifiers at a maximum level of 1%
of any one emulsifier or any mixture of emulsifiers.

Nutritive carbohydrate sweeteners with varying
degrees of sweetness intensity useful in the present
invention may be any of those typically used in the art
15 and include, but are not limited to, sucrose, (e.g.,
from cane or beet), dextrose, fructose, lactose,
maltose, glucose syrup solids, corn syrup solids, invert
sugar, hydrolyzed lactose, honey, maple sugar, brown
sugar, molasses and the like. The nutritive
20 carbohydrate sweetener, preferably sucrose, will be
present in the chocolate as crystals or particles.

As indicated hereinabove, the particle size of
the ingredients, especially the sweetener, can influence
the viscosity of the chocolate. Particle sizes can be
25 measured by various techniques known to those skilled in
the art. These techniques include the Malvern® laser
light scattering technique, measurement using a
micrometer and measurement using a microscope and the
like. Unless otherwise specified herein, when referring
30 to the particle size of the nutritive carbohydrate
sweetener, the measurements were taken using the

1 Malvern® laser light scattering technique. Furthermore,
unless otherwise specified herein, when referring to the
particle size of the finished chocolate, the
measurements were taken using a micrometer. In a
5 preferred embodiment, the particle size of the nutritive
carbohydrate sweetener and the nonfat cocoa solids are
within a certain specified range in order to maintain
specified rheological properties.

In an embodiment of the present invention, the
10 size of the particles of the nutritive carbohydrate
sweetener are substantially all between 1 to 60 microns.
In a preferred embodiment, substantially all of the
particles are between about 3-50 microns in size. In an
even more preferred embodiment, substantially all of the
15 particles are between about 5-40 microns in size. Less
than 5% of the particles would be below the lower limit
and less than 2% of the particles would be above the
upper limit on a weight basis.

Maintaining substantially all of the nutritive
20 carbohydrate sweetener particles greater than 1 micron
allows use of minimum amounts of fat to develop the
taste, texture and flow properties similar to a full-fat
product. Particle sizes above 60 microns cause
graininess.

25 In a preferred embodiment of the present
invention, the chocolate or chocolate food product has
22-24.5% by weight of total fat or reduced calorie fat

As used herein, unless otherwise specified, all
percentages are calculated on a weight basis of
30 ingredient to chocolate. For example, if an ingredient

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1 is present in 10%, it is meant that there are 10 g of
that ingredient in 100 g of chocolate.

The chocolates of the present invention may
contain a trace of water. It is preferred that they
5 contain less than 1% moisture, preferably less than
0.75% by weight, in order to meet the flow requirements.
Higher moisture is very detrimental to the Casson yield
value and plastic viscosity and would otherwise require
substantial additional fat to counteract its negative
10 effect on rheology.

The chocolates of the present invention may
additionally contain optional ingredients. These
optional ingredients include nonfat milk solids, nonfat
cocoa solids, sugar substitutes, natural and artificial
15 flavors (e.g., vanillin, spices, coffee, ethyl vanillin,
salt, brown nut-meats, natural vanilla, etc., as well as
mixtures of these), antioxidants (e.g., preservatives
such as TBHQ, tocopherols and the like), proteins, and
the like.

20 In a preferred embodiment, the chocolate contains
substantially all particles having a size of less than
45 microns as measured by a micrometer for coatings and
less than 40 microns for solid bars and novelty shapes.

The preparation of a lowfat chocolate or a
25 lowfat/reduced calorie chocolate having a fat content as
low as 20% is prepared by the process described herein.
In this process, the trick was to find a means of
reducing the fat content while maintaining the
rheological properties suitable for enrobing, moulding
30 or extruding. The present inventors have developed such
a process.

1 The process described herein is a general process
for preparing these lowfat and lowfat/reduced calorie
chocolates. However, the preferred products prepared by
this process are the lowfat chocolates or the
5 lowfat/reduced calorie chocolates defined herein wherein
the fat content or the reduced calorie fat content,
where applicable, is in the range from 20 to 24.5%, and
more preferably from 22.0-24.5%.

As was described above, fat in chocolate, for
10 rheological and organoleptic purposes is needed to coat
all the surfaces of the solid and to fill the voids
between these solids. If the total surface area and
porosity of the solids is reduced, the fat requirements
will be reduced. The total surface area and porosity
15 can be reduced by two methods: either by reducing the
surface area of the nutritive carbohydrate sweetener by
a water addition and recrystallization operation, or by
densifying some or all of the solids.

In U.S. Patent No. 5,080,923 (Martin), granulated
20 nutritive carbohydrate sweetener is first reduced in
particle size to the finished product specification by
various methods including milling and roll refining.
Either before or after size reduction, the nutritive
carbohydrate sweetener is blended with fat, i.e., cocoa
25 butter. At this point water is blended into the
mixture. The water dissolves the ultrafines (particles
below 10 microns) and dissolves the angular and jagged
edges of the larger particles. The mixture is dried.
During drying, the nutritive carbohydrate sweetener in
30 solution recrystallizes on the larger nutritive
carbohydrate sweetener crystals which further rounds and

1 smooths the particles. As a result of this procedure,
an overall reduction of as much as 50% in surface area
can be achieved. However, during the drying process,
the nutritive carbohydrate sweetener has a tendency to
5 agglomerate into particle sizes above the finished
particle specification. To disperse these particles and
achieve a smooth creamy texture in the finished
chocolate, an additional size reduction step is
required. Unfortunately, the additional step will not
10 only disperse the agglomerates but may also crush
individual particles and significantly increase the
total surface area by introducing new ultrafines and
angular and jagged surfaces. This additional surface
area limits the fat savings potential of the technology
15 and chocolates so that chocolates with only 27% fat can
be obtained. However, the present invention overcomes
the limitations inherent in Martin and brings the total
fat content below 25%.

The improved process of refining nutritive
20 carbohydrate sweetener crystals of the present invention
eliminates the problem of agglomeration and the second
size reduction step of Martin through the use of
surfactants or emulsifiers. As in Martin, fat and
nutritive carbohydrate sweetener are mixed and then
25 passed through a particle size reduction process,
typically roll refining or nutritive carbohydrate
sweetener milling as shown in Figure 1. In the roll
refining process, the fat or reduced calorie fat or
combination thereof and nutritive carbohydrate sweetener
30 are mixed in batch mixer 2 to form a mixture 4 which is
then passed through the nip of at least one pair of roll

1 refiners (6, 8) to produce a mixture 10 having particles
smaller than about 50 microns. Water, in the amount of
1 to 10% by weight of the nutritive carbohydrate
sweetener, is added to the mixture 10 for the purpose of
5 dissolving fines and rounding larger crystals.

Alternatively, the mixture 10 can be prepared by
first refining the nutritive carbohydrate sweetener in a
mill 18 and then blending the nutritive carbohydrate
sweetener with the fat or reduced calorie fat or
10 combination thereof in a blender 30 in accordance with
procedures known to one skilled in the art.

In the prior process, when the mixture 10 is
dried, agglomeration occurs. It has been discovered by
the present inventors that adding a surfactant to the
15 mixture 10 before drying prevents agglomeration.
Accordingly, the addition of surfactants, e.g.,
lecithin, preferably in amounts less than 1% by weight,
in the presence of small amounts of water, preferably 1-
5% by weight, along with agitation throughout the drying
20 process will prevent agglomeration. For the drying
step, both batch and continuous driers yield a flowable,
non-agglomerated paste. For batch drying, typical
chocolate conches 12 yield good results. Typical drying
times are from about 60 to about 120 minutes at
25 temperatures of about 120 to about 160°F. For
continuous drying, paddle driers 14 have proven
successful. Typical drying times for paddle dryers are
approximately 40 to about 120 minutes at temperatures of
about 120 to about 180°F for acceptable results. Both
30 drying processes result in a nutritive carbohydrate
sweetener/fat paste 16 which is agglomerate free,

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flowable and has low viscosity. Preferably, in accordance with the present invention, the drying produces a product having 10-24% of fat (w/w) in the nutritive carbohydrate sweetener/fat paste. The moisture content is preferably less than 0.2% wt. No secondary size reduction step is necessary. This paste is then added to the other ingredients which have been reduced to finished particle size specification. This final mixture is conched and standardized to the
10 specified fat level.

The process of the present invention also allows for flexibility in design. The desired reduction of the surface area of the nutritive carbohydrate sweetener can be accomplished with other confectionery ingredients present during the water/surfactant addition. These ingredients include chocolate liquor, cocoa powder, and milkfat.

Another method of reducing the surface area of the particle size of the sugar is by controlling the
20 crystallization of a supersaturated solution of sugar while drying the sucrose syrup.

An additional method calls for the size reduction of sugar by any number of accepted milling techniques. A *Micropul ACM mill will reduce the particle size of sugar within the desired range with a reduction of ultrafines and total surface area as compared to typical roll refining. Once the sweetener size has been reduced, the total surface area can be further reduced by physically removing particles below a specified size. Air classification can successfully separate smaller
30 particles by taking advantage of the weight difference

*Trade-mark

1 between the lighter small particles and the heavier
larger particles. Other methods, such as screening, are
also possible in removing the ultrafines from the size-
reduced nutritive carbohydrate sweetener.

5 Aside from preparing the particle size of the
nutritive carbohydrate sweetener, another method of
reducing surface area is to densify any or all of the
ingredients. In particular, dried milk solids can be
greatly densified. Typically, spray dried whole milk
10 powder (WMP) and spray dried non-fat milk solids (NFMS)
are used in chocolate. Low density, highly porous
sponge-like particles are created by the spray drying
process. The density of the powder can be increased to
a particularly dense state by either altering the spray
15 drying process or by further processing of the dried
product.

In a preferred embodiment, the nonfat milk solids
are pretreated to compact the structure and crystallize
a substantial portion of the lactose present in the milk
20 solids. The bulk density (packed) should preferably
exceed 0.7 g/ml and the degree of lactose conversion
from the amorphous to crystalline state shall preferably
exceed 30%, more preferably above 70%. Thus, nonfat dry
milk powder can be prepared one of three ways to satisfy
25 the preferred embodiment.

By introducing a lactose crystallization step
before spray drying, the density of the dried powder is
greatly increased. By precrystallizing the lactose, it
enters the spray drier in a dense alpha monohydrated
30 crystalline state and does not "puff-up" in a porous

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1 amorphous state. With lactose making up over 50% of
NFMS, the overall density of the NFMS is increased.

For normal spray dried powder, the density can be
increased by rewetting the powder and drying under
5 pressure. The NFMS is dispersed into water (15 to 30%
added water by weight relative to the NFMS) and dried
under pressure either in a melange or through roll
refiners. A secondary drying step is necessary to bring
the final moisture to below 3%. During this process,
10 the amorphous lactose is dissolved and dried in a
crystalline state. The other solids are also
pressurized and dried into a more collapsed, less porous
state.

In a further method, the nonfat spray dried milk
15 powder can also be compacted with sufficient heat and
water in a twin screw extruder to collapse the protein
structure and crystallize the amorphous lactose.

Apart from reducing the need for fat in
confectionery items, another method to reduce fat is to
20 make the fat which is present more functional. Much of
the fat in typical chocolate products may be bound in
some way and consequently are not available for
lubrication. In WMP, as much as 90% of the milkfat may
be trapped within the dried spheres. In chocolate
25 liquor, some of the fat may be bound within the cellular
structure. The present invention includes processes
which will free the bound fat and allow it to be used
for lubrication, consequently reducing the need for
additional fat which would be required for the same
30 purpose.

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1 In the case of WMP, the fat can become functional
by a number of methods. NFMS with anhydrous milkfat
(AMF) may be used to replace WMP. In this case nearly
100% of the milkfat becomes functional. Also, the WMP
5 can receive post-processing to free the fat. The method
of rewetting and drying under pressure as described
above will free the fat from the spray dried particles.
As the lactose dissolves and the structure breaks down,
the milkfat is freed and becomes functional. The fat
10 can also be released by blending 2 to 10% moisture with
the WMP and processing through a high shear twin screw
mixer. In this process, the WMP particle is softened by
the water and the shear which allows the fat to escape.

When producing a non-standard chocolate product,
15 bound fat in liquor may be made available by pressing
the liquor to a low fat level, e.g., 8 to 12% by weight.
The pressing of the liquor will rupture the cellular
structure of the cocoa solids allowing cocoa butter to
escape. This process reduces the fat in the cocoa
20 solids and allows a total reduction in fat in the
finished product without a loss in product quality or an
increase in viscosity. A further reduction may be
achieved by extracting the fat with solvents. In this
case, the fat content of the cocoa powder will be well
25 below 8% by weight and a greater fat reduction may be
achieved.

Each of the above methods make it possible to
reduce the fat content of chocolate products without
increasing the viscosity or lowering the textural
30 quality. In order to lower the fat content to below 25%
and as low as 20% by wt., normally, these methods must

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1 be used in some combination. For milk and white
chocolate, low fat levels can be achieved by using the
improved process of refining the saccharide crystals and
a combination of NFMS and AMF to replace the WMP. For
5 dark and semi-sweet chocolates, the modified process of
refining the saccharide crystals is needed for low fat
production.

Figure 2 generally illustrates a process for
preparing a lowfat chocolate in accordance with the
10 present invention. Fat (e.g., cocoa butter) and
nutritive carbohydrate sweetener or non-sugar sweetener
are mixed in a batch mixer 2. As used herein, the non-
sugar sweetener refers to a high potency sweetener or
polyol or combination thereof. The mixture is
15 subsequently refined by being passed through the nips of
a plurality of roll refiners (6, 8) to produce a mixture
10 containing sweetener/fat particles (nutritive
carbohydrate sweetener, non-sugar sweetener or
combination thereof/fat particles), preferably smaller
20 than about 60 microns. In this particular embodiment of
the process of the present invention, water and
surfactant are added to the sweetener/fat mixture and
subjected to the drying process e.g., in a paddle dryer
14 (or in a conch) to obtain an 18 to 24% fat by weight
25 sweetener/fat paste 16 with a moisture content of less
than 0.2% wt. and which can be placed in storage 20.

Apart from the preparation of the sweetener/fat
paste described above, the other chocolate-making
ingredients may be prepared separately. Said additional
30 ingredients include, but are but not limited to, nonfat
milk solids, cocoa powder, chocolate liquor, lactose,

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1 milkfat, whole milk powder or mixtures thereof. With
respect to Figure 2, chocolate liquor, nonfat milk
solids and anhydrous milkfat, and cocoa butter are mixed
in a batch mixer 2' and subsequently refined by being
5 passed through the nips of a plurality of roll refiners
(6', 8') to produce a mixture 22 having particles
preferably smaller than about 50 microns.

The sweetener/fat paste 16 can then be mixed with
the mixture 22 in a conch 24 while heating to give the
10 final desired consistency to the chocolate. Additional
fat and emulsifiers, e.g., lecithin, anhydrous milkfat
and cocoa butter, are then added in the standardizing
step, as shown in Figure 2, to adjust the viscosity of
the chocolate to final specifications and to produce a
15 20-24.5% fat chocolate.

Figure 3 illustrates a variation on the version
of the process shown in Figure 2. In the process shown
in Figure 3, after refinement, in accordance with the
procedure described above and outlined in Figure 2, the
20 sweetener/fat mixture 10 is immediately subjected to a
batch drying process in a conch 24. No paddle drying is
used in this methodology, as in Figure 2. The remainder
of the process is similar to that of Figure 2. More
specifically, the other ingredients, e.g., liquor, NFMS,
25 AMF, and cocoa butter are added, conched and
standardized as in Figure 2.

Figure 4 illustrates a further variation on the
process of the present invention. Figure 4 relates to
the process of making a low fat/low caloric chocolate.
30 A reduced calorie fat, such as Caprenin, is mixed with a
sweetener comprising a non-nutritive sweetener and a

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1 nutritive sweetener and refined in accordance with the
procedure described in the text hereinabove with regard
to Figure 2. This sweetener/lowfat mixture 10' is then
dried by the techniques as described in relation to
5 Figure 2. For example, a paddle drier or a conch 12,
such as illustrated in Figure 4 can be used to produce a
sweetener/lowfat paste 16' with a moisture content of
less than 0.2% wt., and which can optionally be placed
in storage.

10 The other lowfat/low calorie making ingredients,
e.g., NFMS, liquor, bulking agents (such as polydextrose
and the like), cocoa powder, flavors and low calorie
fat, are prepared separately, as described above to
produce a mixture 22' having particles preferably
15 smaller than about 50 microns. The mixture 22' can then
be mixed in a conch 24 while heating to give the final
desired consistency to the chocolate. Additional fat,
reduced calorie fat and surfactant are then added in
the standardizing step, e.g., lecithin, AMF, cocoa
20 butter and additional reduced calorie fat, to adjust the
viscosity of the chocolate to final specifications and
to produce a 20-24.5% fat reduced calorie chocolate.

Figure 5 shows yet another variation of the
process of the present invention and illustrates the
25 process of making a low fat/reduced calorie chocolate
analogous to the process illustrated in Figure 3, except
that reduced calorie ingredients, e.g., low calorie
fats, and bulking agents are used instead of fat.

The chocolates of the present invention can be
30 used in a solid bar in which the entire bar is made up
of solely chocolate. The solid bar is preferably a

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1 geometrical shape, for example, a circle, a rectangle or
a square.

The chocolates of the present invention can additionally be used as a coating. As used herein, the
5 term "coating" refers to a food which is covered or enveloped with a chocolate. Various foods which may be coated include fruits (e.g. cherries, strawberries, bananas and the like), marshmallow, cake, cookies, toffee, peanut butter, caramel, nuts, raisins, nougat,
10 baked goods, ice cream bars, candy bars, puddings, creams and the like. Consequently, as used herein, a solid bar with inclusions is a type of coating.

Apart from being used in a solid bar and as a coating, the chocolates of the present invention can
15 also be used in making novelty shapes as previously defined.

The preferred chocolate made according to the process of the present invention, which has desirable flow properties, contain 20 to 24.5% wt. total fat,
20 preferably 22 to 24.5%. In addition, it preferably contains less than 7% milkfat, less than 1% moisture, preferably below 0.75 % wt., and 35% minimum, preferably over 40%, nutritive carbohydrate sweetener with specific limitations on the sweetener particle size. Because of
25 this unique composition, the chocolate of the present invention meets flow requirements for both moulding or enrobing. The values are presented in Table 1. It is noted that a different relationship than suggested by Chevalley (1970) of yield value and viscosity was
30 observed due to the ability of the present invention to generate chocolate with uniquely low yield values.

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1 These uniquely low yield values allow chocolates with higher viscosities than suggested by Chevalley to function as coating chocolates in a production setting.

5 TABLE 1. RHEOLOGICAL VALUES

		<u>PREFERRED</u>	<u>MOST PREFERRED</u>
	A. For Solid Bars		
	-Casson Yield Value (dyn/cm ²)	< 200	< 100
	-Casson Plastic Viscosity (poise)	< 200	< 150
10	-Micrometer particle size of chocolate	< 40	< 30
	B. For Coatings or solid bars with inclusions (enrobing, shell moulding)		
	-Casson Yield Value (dyn/cm ²)	< 80	< 35
	-Casson Plastic Viscosity (poise)	< 80	< 170
15	Sum of Casson yield Value and Casson Plastic Viscosity	< 160	< 205
	-Micrometer particle size of chocolate	< 45	< 45
	C. For Novelty Shapes-Extruded Chocolates (example-Kisses ®)		
20	-Casson Yield Value (dyn/cm ²)	<2000	< 300
	-Casson Plastic Viscosity (poise)	< 200	< 200
	-Micrometer particle size of chocolate	< 40	< 30

Milk chocolate must also, in addition to the requirements already given for the total fat, milkfat, moisture, rheology, and nutritive carbohydrate sweetener, contain a minimum of 8.61% milk solids-nonfat and 10% chocolate liquor, a range of 3.39-7.00% milkfat and maximum 1% safe and suitable emulsifier. The more preferred levels are 12-20% milk solids-nonfat, 3.39-5.00% milkfat, 12-15% chocolate liquor, and 0.5% maximum emulsifier. Cocoa butter may be added as needed to

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1 reach the desired total fat content. The proportion of
milkfat to cocoa butter is important so that the desired
degree of hardness is achieved in the chocolate. The
milkfat component can be delivered by anhydrous milkfat
5 (AMF), cream, butter, whole milk powder, nonfat milk
powder or any mixture thereof.

A skim milk chocolate can be formulated by
keeping the milkfat component under 3.39%, preferably
under 1%, and raising the minimum milk solids nonfat
10 component to 12%. A buttermilk chocolate is similar to
skim milk chocolate except that dried sweet cream
buttermilk serves as the milk solids nonfat component.

Mixed dairy product chocolates are similar to
milk chocolate except the milkfat component may be below
15 3.39%. It is preferred that the milkfat component is 0
to 7%, and more preferably 0 to 5.5%. Mixed dairy
product chocolates allow a wider choice as to the type
of milk solids nonfat component.

Sweet chocolates are similar to milk chocolates
20 except the chocolate liquor content is usually 15-35%
and the total milk solids may not exceed 12%. For this
invention the milkfat component preferably ranges from 0
to 7%, and more preferably from 0 to 3.5%. Semi-sweet
chocolate (or bittersweet chocolate) is similar to sweet
25 chocolate except the chocolate liquor content exceeds
35%.

A white chocolate of this invention conforming to
the proposed standard of identity granted to Hershey
Foods Corporation under a temporary marketing permit (56
30 Fed. Reg. 46798, September 16, 1991) would preferably
contain 23.5-24.5% total fat consisting of 3.5-4.5%

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milkfat and 20.0-21.0% cocoa butter, 35-55% nutritive carbohydrate sweetener, preferably 40-55%, 10.5% minimum milk solids nonfat, preferably 12-25%, and less than 0.5% chocolate liquor, preferably 0%.

Nonstandardized chocolates may contain sugar substitutes. Vegetable fats other than cocoa butter may replace some or all of the chocolate liquor to prepare a chocolate flavored confectionery such as compound coatings or imitation chocolate bars. Nonstandardized
10 chocolates may also contain cocoa powders as partial or total substitutes for chocolate liquor. In a preferred embodiment, coarsely ground cocoa powder replaces over 50% of the total cocoa solids and is prepared by grinding or pulverizing a cocoa presscake so that less than 75% will pass through a U.S. standard screen #200 and less than 50% through a #400 screen. (Commercially available cocoa powders typically are ground in high impact mills such that 98%+ pass through a #200 screen and 90%+ through a #400 screen.) This coarsely ground
20 cocoa powder can be fed into the nip of a roll refiner and final particle size reduction is accomplished by the rolls. This prevents the formation of an excessive amount of fine particles below 5 microns and thereby limits surface area which would otherwise require one to add more total fat in the chocolate for proper flow.

Chocolate with only 20-24.5% total fat is an excellent starting point for developing reduced calorie nonstandardized chocolates. A product with reduced calories can readily be obtained by utilizing a reduced
30 calorie fat (such as *Caprenin and the like), a sugar substitute or combinations thereof.

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1 When the sugar substitute partially replaces the
nutritive carbohydrate sweetener or when the reduced
calorie fat partially or totally replaces the fat, or
combination thereof, the resulting chocolate is a low
5 fat reduced calorie chocolate. The low fat reduced
calorie chocolate is a type of low fat chocolate as
defined herein. This chocolate contains the same
ingredients as the low fat chocolate as described
hereinabove, with the noted exceptions. Thus, this low
10 fat reduced calorie chocolate also contains an edible
emulsifier and optionally nonfat cocoa solids. It may
also contain trace amounts of water. Further it may
contain the other ingredients found in the various types
of chocolate described hereinabove, e.g. milk chocolate,
15 skim milk chocolate, buttermilk chocolate, mixed dairy
product chocolate, sweet chocolate, semisweet chocolate,
bittersweet chocolate, white chocolate, and non-
standardized chocolate, with the above exceptions.
Further, this reduced calorie low fat chocolate contains
20 the rheological characteristics of the low fat chocolate
described herein.

Tables 2A through 2G present various formulations
of different standardized chocolates made in accordance
with the present invention.

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1 **TABLE 2A. STANDARDIZED MILK CHOCOLATE COMPOSITIONS
MADE IN ACCORDANCE WITH THE PRESENT INVENTION**

COMPOSITION		
Ingredients	Amount (% wt.)	
	Broad	Preferred
Total Fat	20-24.5	22-24.5
¹ Sweetener: Nutritive Carbohydrate Sweetener	>35	
Sucrose		>40
Milk Solids (nonfat): NFMS, WMP or any mixture	≥8.61	
NFMS ²		12-20
Milkfat: Milkfat, cream, butter or from WMP	>3.39	
Anhydrous milkfat (AMF)		3.39-5.50
Cocoa Solids: Chocolate liquor	≥10	12-15
Emulsifier: Any safe and suitable emulsifier	≤1.0	
Lecithin or DATEM or any combination thereof		<1.0
Moisture Content	≤1.0	<0.75

25 ¹ Have been pretreated to meet the particle size requirement (substantially all between 1-60 microns, 3-50 microns preferred, and 5-40 microns most preferred; less than 5% of sweetener below lower limit and 2% above upper limit on a weight basis) by: (1) a refining and wetting process as described in U.S. Patent No. 5,080,923 and improved herein to eliminate sugar fines; (2) a boiled sugar crystallization technique, or (3) grinding followed by size classification to remove both coarse sugar
30 crystals and fine sugar particles.

² With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

1 **TABLE 2B. STANDARDIZED SKIM MILK CHOCOLATE COMPOSITIONS
MADE IN ACCORDANCE WITH THE PRESENT INVENTION**

5	COMPOSITION (same as standardized milk chocolate except for:)		
	Ingredients	Amount (% wt.)	
		Broad	Preferred
10	Total Fat	20-24.5	22-24.5
	Milk Solids (nonfat): NFMS	≥12	
	NFMS ²		12-20
	Milkfat: Milkfat, cream, butter or from NFMS	≤3.39	
	Only from NFMS		<1

15 ² With over 30% lactose crystallization, preferably 70% or
more, and bulk density (packed) over 0.7 g/ml.

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TABLE 2C. STANDARDIZED BUTTERMILK
CHOCOLATE COMPOSITIONS MADE IN ACCORDANCE WITH
THE PRESENT INVENTION

COMPOSITION (same as standardized milk chocolate except for:)		
Ingredients	Amount (% wt.)	
	Broad	Preferred
Total Fat	20-24.5	22-24.5
Milk Solids (nonfat): Dried sweet cream buttermilk	≥12	
Dried sweet cream buttermilk ²		12-20
Milkfat: Milkfat, cream, butter or from dried sweet cream buttermilk	≤3.39	
Only from dried sweet cream buttermilk		<1

² With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

1 **TABLE 2D. STANDARDIZED MIXED DAIRY PRODUCT
CHOCOLATE COMPOSITIONS MADE IN ACCORDANCE WITH
THE PRESENT INVENTION**

5	COMPOSITION (same as standardized milk chocolate except for:)		
	Ingredients	Amount (% wt.)	
		Broad	Preferred
	Total Fat	20-24.5	22-24.5
10	Milk Solids (nonfat): NFMS, WMP, dried sweet cream buttermilk or any mixture	≥12	
	NFMS ²		12-20
	Milkfat: Milkfat, cream, butter or from WMP, NFMS or dried buttermilk	0-24.5	
15	AMF		0-5.5

² With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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**TABLE 2E. STANDARDIZED SWEET CHOCOLATE
COMPOSITIONS MADE IN ACCORDANCE WITH
THE PRESENT INVENTION**

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COMPOSITION (same as standardized milk chocolate except for:)		
Ingredients	Amount (% wt.)	
	Broad	Preferred
Total Fat	20-24.5	22-24.5
Milk Solids (nonfat): NFMS, WMP, dried buttermilk or any mixture	≤12	
NFMS ²		0-12
Milkfat	0-12.0	0-3.5
Cocoa Solids: Chocolate Liquor	15-35	15-35

² With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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1 **TABLE 2F. STANDARDIZED SEMISWEET (BITTERSWEET)
 CHOCOLATE COMPOSITIONS MADE IN ACCORDANCE WITH
 THE PRESENT INVENTION**

5	COMPOSITION (same as standardized milk chocolate except for:)		
	Ingredients	Amount (% wt.)	
		Broad	Preferred
	Total Fat	20-24.5	22-24.5
10	Milk Solids (nonfat): NFMS, WMP, dried buttermilk or any mixture	≤12	
	NFMS ²		0-12
	Milkfat	0-12.0	0-3.5
15	Cocoa Solids: Chocolate Liquor	≥35	35-45

² With over 30% lactose crystallization, preferably 70% or more, and bulk density (packed) over 0.7 g/ml.

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1 **TABLE 2G. STANDARDIZED WHITE CHOCOLATE³**
 COMPOSITIONS MADE IN ACCORDANCE WITH
 THE PRESENT INVENTION

5	COMPOSITION (same as standardized milk chocolate except for:)		
	Ingredients	Amount (% wt.)	
		Broad	Preferred
	Total Fat	23.5-24.5	23.5-24.5
10	Sweetener-nutritive carbohydrate sweetener	35-55	40-55
	Milk Solids (nonfat)	≥10.5	10.5-20
	Milkfat	3.5-4.5	3.5-4.5
15	Cocoa Solids: Cocoa Butter ⁴	20.0-21.0	20.0-21.0

³ Based on temporary marketing permit to Hershey Foods Corp. published in 56 Fed. Reg. 46798, September 16, 1991.

⁴ Cocoa powder and chocolate liquor must be absent, i.e., less than 0.5% wt., preferably 0%.

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1 The chocolates prepared in the present invention
can be used in edible food compositions such as
confectioneries, chocolate chips, baking chocolate,
chocolate covered fruits, chocolate covered baked goods,
chocolate covered puddings, and the like. The chocolate
5 of this invention can be used in a direct one to one
substitution in edible food formulations wherever
traditional chocolates are utilized.

 The following examples are provided to further
illustrate the present invention. In the following
10 examples, rheology values of Casson plastic viscosity
and Casson yield value were determined on a cone and
plate system using a CarriMed/Mitech CS Rheometer. The
cone is defined as: truncation of 101 μ m, stress factor
of 0.0597, rate factor of 14.4, diameter of 4 cm and
15 cone angle of 3 degrees and 58 minutes used with a
measurement system inertia of 63.6 dyn cm sec². The
following conditions were used during measurement of the
following chocolate examples: preshear stress of 0
dyn/cm², preshear time of 0 min and equilibration time
20 of 1 min. The experiment mode of shear stress sweep was
done at 40°C starting at 0 dyn/cm² and ending at 2500
dyn/cm² (value of 2500 dyn/cm² used for Example 5) with a
linear stress mode. (The ending shear stress was varied
depending on the chocolate to give about a 9 sec⁻¹ shear
25 rate response of the chocolate.) Ascent time was 8 min
with no hold time at maximum shear stress followed by an
8 min descent time. Casson plastic viscosity and Casson
yield value were calculated from the shear stress/shear
rate data using CarriMed software written according to
30 OICCC (1970). "Viscosity of Chocolate-determination of

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1 Chocolate-determination of Casson yield value and Casson
plastic viscosity", Analytical Methods, Analytical
Methods of the Office International du Cacao et du
Chocolat, pg. 10-E. The average of 3 ascending and 3
5 descending values of Casson yield value or Casson
Plastic viscosity were averaged together to provide the
rheology values which are set forth in the examples.

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EXAMPLE 1

Sucrose and caprenin were combined at 20.78% fat and refined to 25 μ m. The refined sucrose/caprenin mixture was mixed in a 5 qt bowl using a Hobart N-50 mixer with an external bath temperature of 60°C on speed 1. 3.2% distilled deionized water (referenced to the sucrose/caprenin mass) was added to sucrose/caprenin mixture while mixing. Within 10 minutes, 0.28% fractionated lecithin (40% phosphatidyl choline) (referenced to the sucrose/caprenin mass) was added and the sucrose/caprenin/lecithin mixture continued mixing until the water was removed resulting in a paste labeled "special process sugar". To 625 g of special process sugar, the following ingredients were added: 160 g of spray-dried nonfat milk (the lactose was crystallized by agitating and incubating concentrated skim milk prior to spray drying), 50 g polydextrose, 70 g cocoa powder (coarse ground), 21 g cocoa butter, 0.2 g vanillin, 12 g caprenin. This mixture was refined to 25 μ m and then mixed on a *Hobart N-50 mixer in a 5 qt Hobart bowl at 60° C. for 2 hr on speed 1. At the end of 4 hr, the nonstandardized chocolate paste was adjusted to 23.5% total fat with the addition of Caprenin and 0.5% fractionated lecithin (40% phosphatidyl choline). The particle size by micrometer of the final non-standardized chocolate was 25 μ m having a Casson yield value of 52 dyn/cm² and a Casson plastic viscosity of 50 poise. Compared to the leading solid milk chocolate bar, both calories and fat were reduced by 25%.

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*Trade-mark

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EXAMPLE 2

The same process as Example 1 was followed except that the amounts of the ingredients differed slightly prior to the second refining. To 683 g special process
5 sugar, the following ingredients were added: 170 g of lactose-crystallized spray dried nonfat milk, 27 g polydextrose, 73 g coarse-ground cocoa powder, 15 g cocoa butter, 0.2 g vanillin, 5 g caprenin. This mixture was refined and mixed as in Example 1 and then
10 adjusted to 0.5% fractionated lecithin (40% phosphatidyl choline) and 20% total fat with the addition of caprenin. The final non-standardized chocolate had a micrometer particle size of 26 μ m, a Casson yield value of 130 dyn/cm² and a Casson plastic viscosity of 186
15 poise. Compared to the leading solid milk chocolate bar, calories were reduced 25% and the fat was reduced 36%.

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EXAMPLE 3

The special process was followed as explained in Example 1 except that the fats added to the sucrose were 81.6% cocoa butter and 18.4% milkfat. However, the additional ingredients (denoted as "others") were refined separately from the special process sugar and were as follows: 160 g lactose-crystallized spray-dried nonfat milk, 135 g chocolate liquor and 0.2g vanillin. The others were refined to 30 μ m. Then, 295 g others were combined with 691 g special process sugar and mixed as in Example 1 and then standardized to 23.5% fat using milkfat and 0.4% fractionated lecithin (40% phosphatidyl choline). The final milk chocolate had micrometer particle size of 30 μ m, a Casson yield value of 20 dyn/cm² and Casson plastic viscosity of 93 poise.

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EXAMPLE 4

The process for the special process sugar of Example 3 was followed as above except that the emulsifier added was diacetyl tartaric acid esters of 5 mono- and diglycerides (DATEM). The others were as in Example 3 and were refined to 40 μ m and combined with the special process sugar as in Example 3. After mixing the chocolate as in Example 3, the chocolate was adjusted to 23.5% total fat with the addition of milkfat and to 10 0.44% total emulsifiers by the addition of fractionated lecithin (35% phosphatidyl choline). The final milk chocolate had a micrometer particle size of 39 μ m, a Casson yield value of 16 dyn/cm² and a Casson plastic viscosity of 114 poise.

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EXAMPLE 5

The special process sugar was produced as follows: 580 g sucrose was combined with 8 g milkfat, 135 g chocolate liquor and 87 g cocoa butter. This
5 composition was refined to 25 μ m. The refined composition was treated as in Example 1 for processing of the special process sugar. The "others" were composed of 160 g lactose-crystallized spray dried nonfat milk, 16 g milkfat and 0.2 g vanillin. The
10 "others" were refined to 40 μ m and combined with the special process sugar. After mixing as described in Example 1, the chocolate was adjusted to 20% total fat by addition of milkfat and to 0.4% fractionated lecithin (40% phosphatidyl choline). The milk chocolate's
15 micrometer particle size was 39 μ m with a Casson yield value of 56 dyn/cm² and a Casson plastic viscosity of 184 poise.

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EXAMPLE 6

Special process sugar was prepared in Example 1 except that cocoa butter was used instead of Caprenin. The "others" were composed of 211 g lactose crystallized 5 spray-dried nonfat milk, 0.3 g vanillin, 35 g milkfat and 20 g cocoa butter. These components were refined to 32 μ m and then combined with 698 g special process sugar and mixed as in Example 1. The finished white chocolate was adjusted to 24% total fat using cocoa butter and 10 0.34% total emulsifiers with the addition of soya lecithin. The micrometer particle size of the final white chocolate was 32 μ m with a Casson yield value of 37 dyn/cm² and a Casson plastic viscosity of 82 poise.

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EXAMPLE 7

Sucrose and cocoa butter were mixed to a ratio of 79/21 and were refined to 30 microns (by micrometer). The refined flakes were loaded in a Frisse DUC 200 conch. While mixing, water was added at 3.2% of the weight of refined flakes. Within 10 minutes, fractionated lecithin was added at 0.3% of refined flakes. The mixture was left mixing at 160°F until the water was removed and resulted in a mixture designated as the special process sugar. In a separate mixer, chocolate liquor and lactose crystallized nonfat milk powder were combined, mixed and refined to 30 microns (by micrometer). The refined chocolate liquor and milk powder were combined with the special process sugar. The combination was conched and standardized with anhydrous milkfat, cocoa butter and lecithin. The milk chocolate final total fat content was 26.4% having a Casson yield value of 15 dyn/cm² and a Casson plastic viscosity of 40 poise.

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EXAMPLE 8

To 1215 g of granulated sucrose, 700 g of chocolate liquor was added, mixed and refined to 30 microns (by micrometer). The refined flakes were added 5 to a 5 quart Hobart mixer. While mixing, 30 g water was added and after 10 minutes 5 g fractionated lecithin was added. The mixture was then mixed for 4 hr at 140 F. The semisweet chocolate was standardized to 24.4% fat resulting in a Casson yield value of 72 dyn/cm² and 10 Casson plastic viscosity of 135 poise.

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EXAMPLE 9

Special process sugar was made according to Example 6 except that a polyglycerol ester was used instead of fractionated lecithin. The others were
5 composed of 69 g lactose, 152 g nonfat milk powder, 115 g chocolate liquor and 2 g diacetyl tartaric acid ester of mono- and diglycerides (DATEM) and were mixed together and refined to 41 microns (by micrometer). The others were combined with 599 g special process sugar,
10 mixed as in Example 1. The final milk chocolate was standardized to 25.0% fat having a Casson yield value of 5 dyn/cm² and a Casson plastic viscosity of 29 poise.

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1 The above preferred embodiments and examples are
given to illustrate the scope and spirit of the present
invention. The embodiments and examples described
herein will make apparent, to those skilled in the art,
5 other embodiments and examples. These other embodiments
and examples are within the contemplation of the present
invention. Therefore, the present invention should be
limited only by the appended claims.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A lowfat chocolate of full-fat texture comprising a fat and nonfat solids comprising nutritive carbohydrate sweetener, and an edible emulsifier, said chocolate containing 20-24.5% fat and being a free-flowing liquid at 40°C.

2. The lowfat chocolate according to claim 1 wherein the nutritive carbohydrate sweetener is present in at least 35% by weight.

3. The lowfat chocolate according to Claims 1 or 2 wherein the nutritive carbohydrate sweetener may be partially substituted with a sugar substitute.

4. The lowfat chocolate according to Claim 3 wherein the sugar substitute is a sugar alcohol, bulking agent or high potency sweetener or combination thereof.

5. The lowfat chocolate according to Claim 4 wherein the bulking agent is polydextrose.

6. The lowfat chocolate according to any one of Claims 3, 4 or 5 wherein the nutritive carbohydrate sweetener is present in the amount of at least 30% by weight.

7. The lowfat chocolate according to any one of Claims 1-6 wherein the edible emulsifier is present in less than 1% by weight.

8. The lowfat chocolate according to any one of Claims 1-7 wherein the emulsifier is lecithin or diacetyl tartaric acid esters of mono- and diglycerides or combination thereof.

9. The lowfat chocolate according to any one of Claims 1-8 wherein the chocolate has a moisture content of less than 1% by weight.

10. The lowfat chocolate according to any one of Claims 1-9 wherein the fat is CAPRENINTM.

11. The lowfat chocolate according to any one of Claims 1-10 wherein the chocolate contains milkfat.

12. The lowfat chocolate according to Claim 11 wherein the milkfat is present in less than 7% by weight.

13. The lowfat chocolate according to any one of Claims 1-12 wherein the chocolate contains non-fat milk solids or non-fat cocoa solids or a combination thereof.

14. The lowfat chocolate according to Claim 13 wherein the non-fat milk solids are present in a range from 12% to 20% by weight.

15. The lowfat chocolate according to any one of Claims 1-14 wherein substantially all of the non-fat solids have particle sizes ranging from 1 to 60 microns.

16. The lowfat chocolate according to any one of Claims 1-15 wherein the particle size of substantially all of the nutritive carbohydrate sweetener is less than 50 microns.

17. The lowfat chocolate according to any one of Claims 1-16 wherein the chocolate has a yield value of less than 2000 dynes/cm² and a plastic viscosity of less than 200 poise at 40°C, and the chocolate is used for extruding.

18. The lowfat chocolate according to any one of claims 1-16 wherein the sum of the numerical values for the yield value and the plastic viscosity is less than 160 at 40°C, the chocolate being used as a coating.

19. The lowfat chocolate according to any one of Claims 1-16 wherein the chocolate is used for molding solid bars and has a yield value of less than 200 dyn/cm² and a plastic viscosity of less than 200 poise at 40°C.

20. The lowfat chocolate according to any one of Claims 1-19 wherein the chocolate is milk chocolate, skim milk chocolate, buttermilk chocolate, mixed dairy product chocolate, sweet chocolate, semisweet or bittersweet chocolate, white chocolate or non-standardized chocolate.

21. The lowfat chocolate according to Claim 20 wherein the milk chocolate contains greater than 35% by weight of a nutritive carbohydrate sweetener, at least 3.3% by weight milkfat, less than 1% by weight moisture, at least 8.6% by weight milk solids-nonfat, at least 10% by weight chocolate liquor and a maximum of 1% by weight edible emulsifier.

22. The lowfat chocolate according to Claim 20 wherein the skim milk chocolate contains greater than 35% by weight of a nutritive carbohydrate sweetener, a maximum of 4% by weight milkfat, less than 1% by moisture by weight, at least 12% by weight milk solids-nonfat, at least 10% by weight chocolate liquor and a maximum of 1% by weight edible emulsifier.

23. The lowfat chocolate according to Claim 20 wherein the buttermilk chocolate contains greater than 35% by weight of a nutritive carbohydrate sweetener, a maximum of 4% by weight milkfat, less than 1% by weight moisture, at least 12% by weight milk solids-nonfat, at least 10% by weight chocolate liquor and a maximum of 1% edible emulsifier.

24. The lowfat chocolate according to Claim 20 wherein the mixed dairy product chocolate contains greater than 35% by weight of a nutritive carbohydrate sweetener, 0-24.5% by weight milkfat, less than 1% by weight moisture, at least 12% by weight milk solids nonfat, at least 10% by weight chocolate liquor and a maximum of 1% by weight edible emulsifier.

25. The lowfat chocolate according to Claim 20 wherein the sweet chocolate contains greater than 35% by weight of a nutritive carbohydrate sweetener, 0-12% by weight milkfat, a maximum of 12% by weight milk solids nonfat, 15-35% by weight chocolate liquor, and a maximum of 1% by weight edible emulsifier.

26. The lowfat chocolate according to Claim 20 wherein the semisweet or bittersweet chocolate contains greater than 35% by weight of a nutritive carbohydrate sweetener, 1-12.0% by weight milkfat, a maximum of 1% by weight moisture, a maximum of 12% by weight milk solids-nonfat, at least 35% by weight chocolate liquor and a maximum of 1% by weight edible emulsifier.

27. The lowfat chocolate according to Claim 20 wherein the white chocolate contains 35-55% by weight of a nutritive carbohydrate sweetener and with a fat content of 23.5-24.5% by weight, 3.5-4.5% by weight milkfat, a minimum of 10.5% by weight milk solids-nonfat, 20.0-21.0% by weight cocoa butter, and a maximum of 1% by weight edible emulsifier.

28. The lowfat chocolate according to Claim 20 wherein the non-standardized chocolate contains greater than 35% by weight of a nutritive carbohydrate sweetener and a maximum of 1.0% by weight moisture.

29. The lowfat chocolate according to any one of Claims 3-28 wherein the chocolate is a low-fat, reduced calorie chocolate containing a mixture of fats, reduced calorie fats or a combination thereof.

30. The lowfat chocolate according to any one of Claims 1-29 wherein the chocolate is an edible composition.

31. The lowfat chocolate according to Claim 30 wherein the edible composition is a confection, baking chocolate or a chocolate chip.

32. A process for making a low fat chocolate of full-fat texture comprising the following steps:

(a) mixing a nutritive carbohydrate sweetener with a fat comprising cocoa butter to form a sweetener/fat mixture;

(b) refining said mixture of step (a);

(c) blending the refined mixture obtained in step (b) with a minor amount of water, said water being present in amounts effective to dissolve the particles having a size less than 10 microns in said sweetener;

(d) adding a surfactant to the mixture of step (c);

(e) agitating and drying the mixture of step (d) to obtain a lowfat nutritive carbohydrate sweetener/fat paste; and

(f) standardizing the paste of step (e) to a desired fat level.

33. A process for making a lowfat reduced calorie chocolate of full-fat texture comprising the following steps:

(a) mixing a nutritive carbohydrate sweetener with a mixture comprising fat comprising cocoa butter and reduced calorie fat to form a sweetener/fat mixture;

(b) refining said mixture of step (a);

(c) blending the refined mixture obtained in step (b) with a minor amount of water, said water being present in amounts effective to dissolve the particles having a size less than 10 micrometers in said sweetener;

(d) adding a surfactant to the mixture of step (c);

(e) agitating and drying the mixture of step (d) to obtain a lowfat sweetener/fat paste; and

(f) standardizing the paste of step (e) to a desired fat level.

34. A process for making a low fat or low fat chocolate of full fat texture comprising:

(a) preparing a supersaturated solution of a nutritive carbohydrate sweetener in water that is substantially free of crystals;

(b) cooling said solution of step (a) and adding to said cooled supersaturated solution 5-20% fat comprising cocoa butter based on the dry weight of the nutritive carbohydrate sweetener;

(c) shearing the mixture of (b) to initiate crystallization;

(d) adding a surfactant to the mixture of step (c);

(e) agitating and drying the product of step (d) under conditions effective to complete crystallization and to substantially remove all of the water, thereby obtaining a lowfat nutritive carbohydrate sweetener/fat paste; and

(f) standardizing the solution of step (e) to a desired fat level.

35. A process for making a low fat chocolate of full fat texture comprising the following steps:

(a) refining a nutritive carbohydrate sweetener in a dry mill and removing from said refined sweetener particles whose size is less than 10 microns;

(b) adding a fat comprising cocoa butter to the product of step (a) to form a sweetener/fat mixture;

(c) blending the mixture in step (b) with a minor amount of water, said water being present in amounts effective to dissolve the particles having a size less than 10 microns in said mixture;

(d) adding a surfactant to the mixture of step (c);

(e) agitating while drying the mixture of step (d) to obtain a low fat nutritive carbohydrate sweetener/fat paste; and

(f) standardizing the paste of step (e) to a desired fat level.

36. A process for making a lowfat reduced calorie chocolate of full-fat texture comprising the steps:

(a) preparing a supersaturated solution of a nutritive carbohydrate sweetener in water that is substantially free of crystals;

(b) cooling said solution of step (a) and adding to said cooled supersaturated solution a mixture of fat comprising cocoa butter and reduced calorie fat, the weight of said mixture being 5-20% of the dry weight of the nutritive carbohydrate sweetener;

(c) shearing the mixture of step (b) to initiate crystallization;

(d) adding a surfactant to the mixture of step (c);

(e) agitating and drying the product of step (d) under conditions effective to complete crystallization and

substantially remove all of the water, thereby obtaining a lowfat nutritive carbohydrate/reduced calorie fat mixture; and

(f) standardizing the solution of (e) to a desired fat level.

37. A process for making a lowfat reduced calorie chocolate of full fat texture comprising the following steps:

(a) refining a nutritive carbohydrate sweetener in a dry mill and removing from said refined sweetener particles whose size is less than 10 microns;

(b) adding a mixture comprising fat comprising cocoa butter and reduced calorie fat to the product of step (a) to form a sweetener/reduced calorie fat mixture;

(c) blending the mixture in step (b) with a minor amount of water, said water being present in amounts effective to dissolve the particles having a size less than 10 microns in said mixture;

(d) adding a surfactant to the mixture of step (c);

(e) agitating while drying the mixture of step (d) to obtain a lowfat fat nutritive carbohydrate sweetener/reduced calorie fat paste; and

(f) standardizing the paste of step (e) to a desired level.

38. The process according to any one of Claims 32-37 wherein the fat or reduced calorie fat is present in the amount

of 10-24% wt. of said sweetener/fat paste of step (e) and said paste contains a moisture content of less than 0.2% by weight.

39. The process according to any one of Claims 32-38 wherein said surfactant is added in an amount of 0.1-0.5% by weight and is lecithin, a fractionated lecithin, diacetyl tartaric acid esters of mono- and diglycerides, polyglycerol esters or mixtures thereof.

40. The process according to any one of Claims 32-39 wherein substantially all of the particles in said chocolate are reduced to less than 50 microns.

41. The process according to any one of Claims 32-40 wherein the final fat content of said chocolate is 20-24.5% by weight total fat.

42. The process according to any one of Claims 32-41 wherein said water of step (c) is added in an amount of at least 10% of the sugar weight.

43. The process according to any one of Claims 32-42 which additionally comprises the following steps subsequent to step (e) and prior to step (f):

(e₁) adding at least one size-reduced ingredient selected from the group consisting of low calorie fat, sugar substitute, cocoa solids, non-fat milk solids, cocoa powder, chocolate liquor, lactose, milkfat, whole milk powder, non-fat milk solids, anhydrous milkfat and mixtures thereof to the paste

of step (e), said ingredient being selected to provide the desired type of chocolate, and

(e₂) conching or liquefying the paste of step (e₁).

44. The process according to Claim 41 wherein said non-fat milk solids are pretreated to compact the structure and crystallize a substantial portion of the lactose present in said milk solids.

45. The process according to Claim 42 wherein said pretreated non-fat milk solids have over 30% lactose crystallization and a bulk density over 0.7 g/ml.

46. The lowfat chocolate according to any of Claims 1-31 wherein substantially all of the particles in the chocolate are less than 50 microns.

47. A process for making a low fat chocolate of full fat texture comprising:

(a) refining a nutritive carbohydrate sweetener in a dry mill;

(b) mixing a fat comprising cocoa butter with said refined nutritive carbohydrate sweetener of step (a) to form a sweetener fat mixture;

(c) blending the refined mixture obtained in step (b) with a minor amount of water, said water being present in amounts effective to dissolve the particles having a size less than 10 microns in said sweetener;

(d) adding a surfactant to the mixture of step (c);

(e) agitating and drying the mixture of step (d) to obtain a lowfat nutritive carbohydrate sweetener/fat paste; and

(f) standardizing the paste of step (e) to a desired fat level.

48. A process for making a lowfat reduced calorie chocolate of full fat texture comprising:

(a) refining a nutritive carbohydrate sweetener in a dry mill;

(b) mixing a fat comprising cocoa butter and reduced calorie fat with the refined nutritive carbohydrate sweetener of step (a) to form a sweetener/fat mixture;

(c) blending the refined mixture obtained in step (b) with a minor amount of water, said water being present in amounts effective to dissolve the particles having a size less than 10 micrometers in said sweetener;

(d) adding a surfactant to the mixture of step (c);

(e) agitating and drying the mixture of step (d) to obtain a lowfat sweetener/fat paste; and

(f) standardizing the paste of step (e) to a desired fat level.

49. The process according to Claim 47 or 48 wherein the fat or reduced calorie fat is present in the amount of 10-24% wt. of said sweetener/fat paste of step (e) and said paste contains a moisture content of less than 0.2% by weight.

50. The process according to any one of Claims 47-49 wherein said surfactant is added in an amount of 0.1-0.5% by weight and is lecithin, a fractionated lecithin, diacetyl tartaric acid esters of mono- and diglycerides, polyglycerol esters or mixtures thereof.

51. The process according to any one of Claims 47-50 wherein substantially all of the particles in said chocolate are reduced to less than 50 microns.

52. The process according to any one of Claims 47-51 wherein the final fat content of said chocolate is 20-24.5% by weight total fat.

53. The process according to any one of Claims 47-52 wherein said water of step (c) is added in an amount of at least about 10% of the sugar weight.

54. The process according to any one of Claims 47-53 which additionally comprises the following steps subsequent to step (e) and prior to step (f):

(e₁) adding at least one size-reduced ingredient selected from the group consisting of low calorie fat, sugar substitute, cocoa solids, non-fat milk solids, cocoa powder, chocolate liquor, lactose, milkfat, whole milk powder, non-fat milk solids, anhydrous milkfat and mixtures thereof to the paste of step (e), said ingredient being selected to provide the desired type of chocolate, and

(e₂) conching or liquefying the paste of step (e₁).

55. The process according to Claim 54 wherein said non-fat milk solids are pretreated to compact the structure and crystallize a substantial portion of the lactose present in said milk solids.

56. The process according to Claim 55 wherein said pretreated non-fat milk solids have over 30% lactose crystallization and a bulk density over 0.7 g/ml.

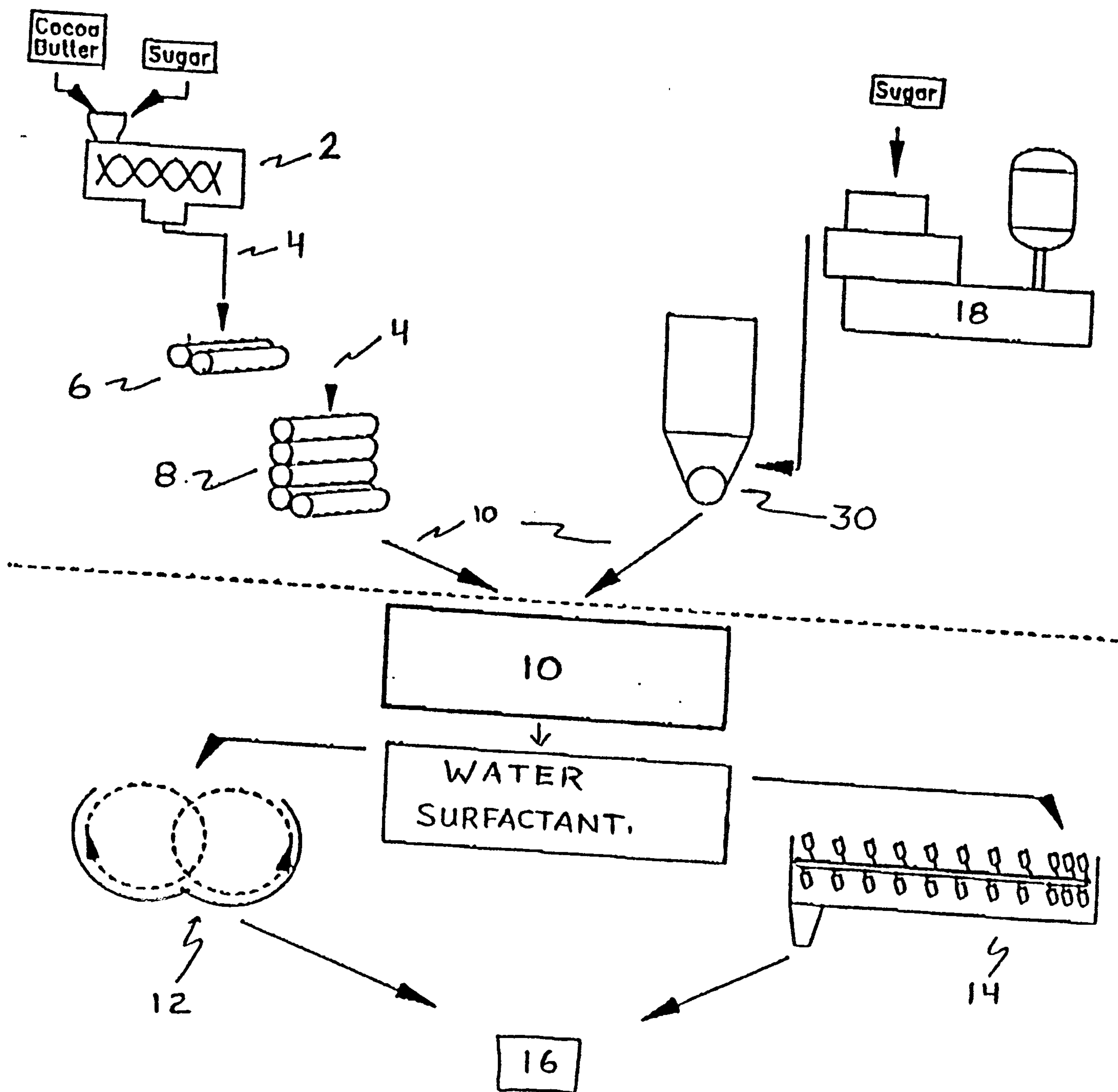


FIG. 1

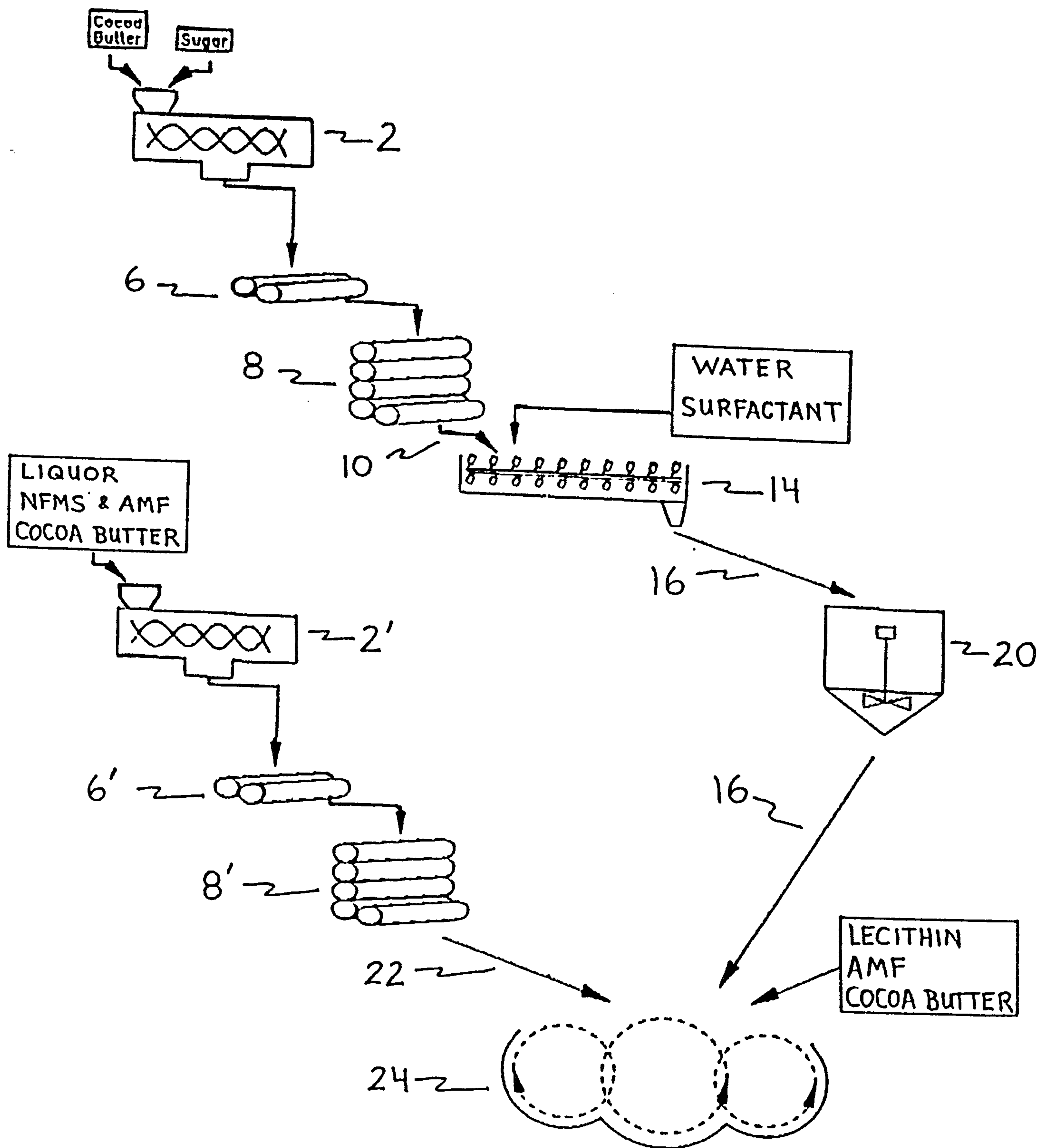


Fig. 2

20% to 24.5% fat Chocolate

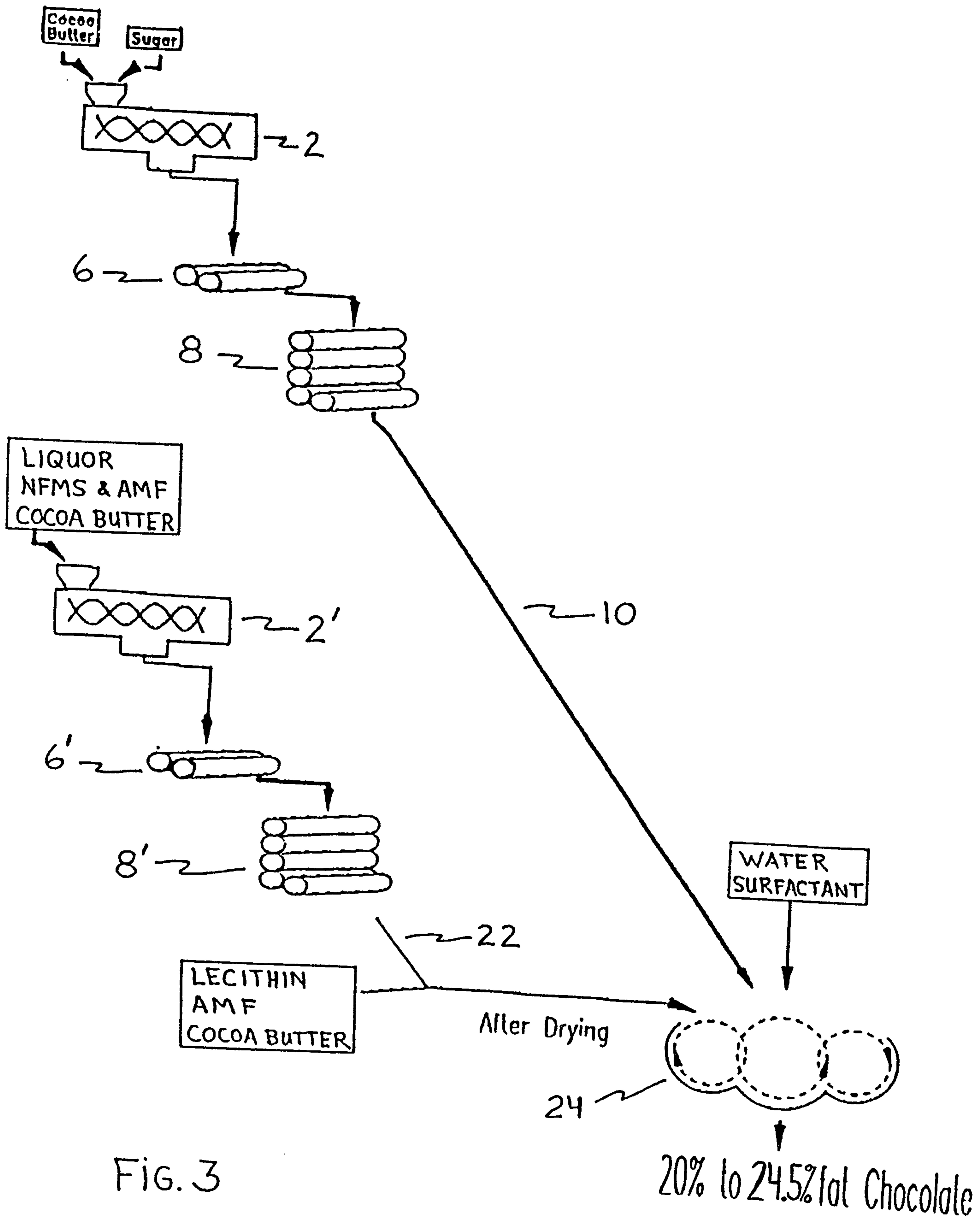


FIG. 3

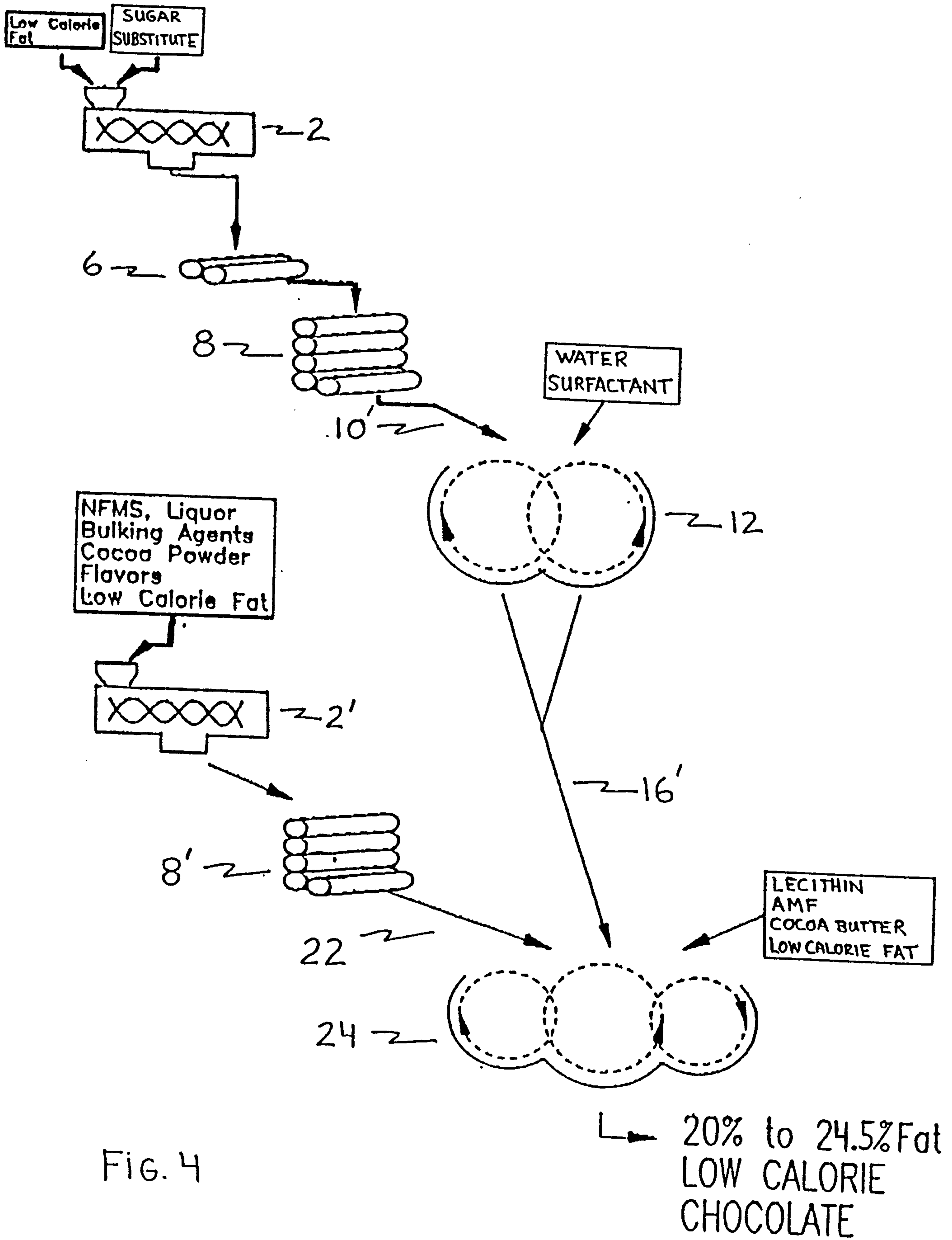


FIG. 4

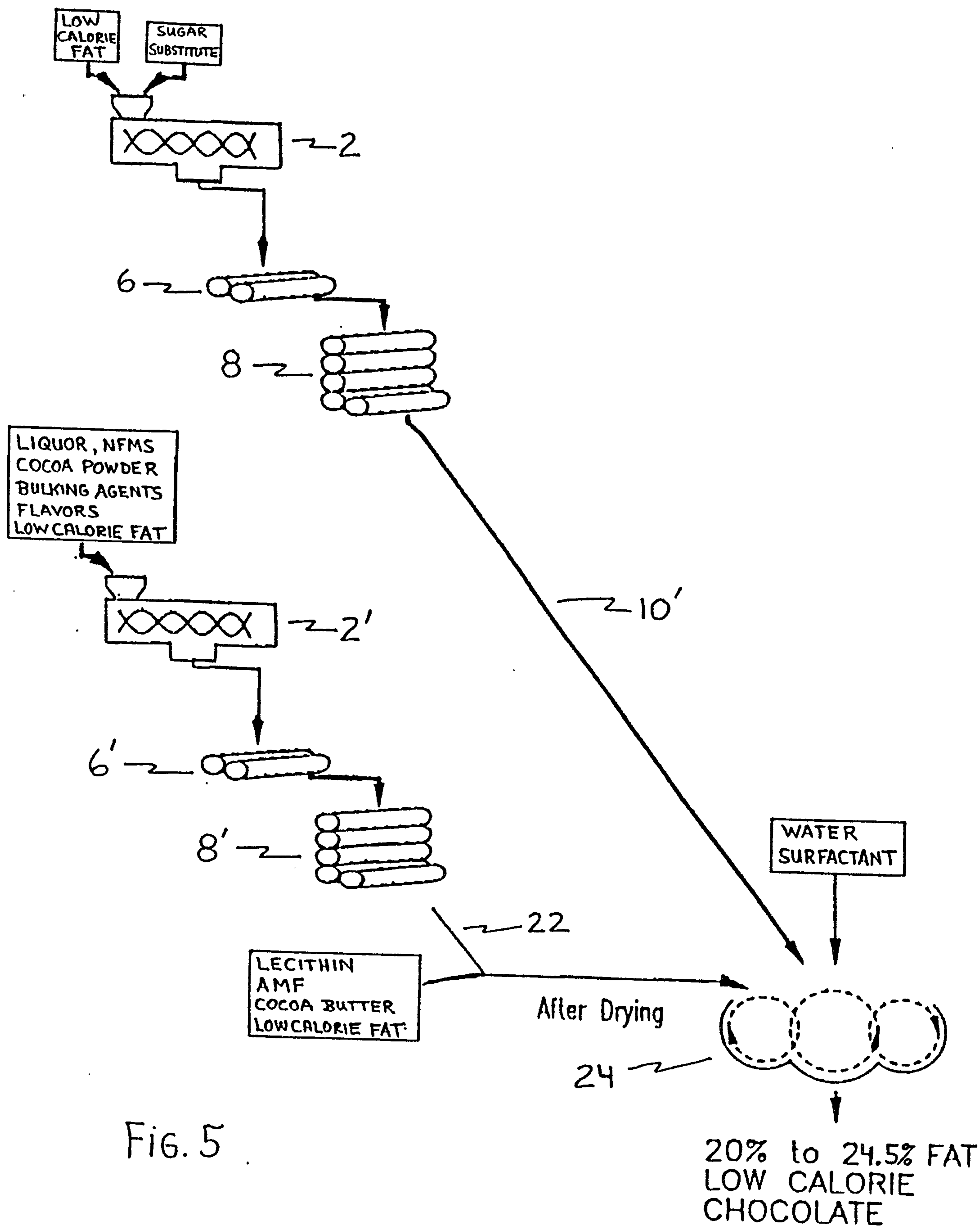


Fig. 5