

Title: ice confection aerated with gas

5 **Field of the invention:** This invention relates to aerated ice confections. It is particularly applicable to milk protein containing confections, eg ice cream, ice milk, frozen yoghurt and frozen custards. These confections are prepared at low temperatures and are intended for
10 consumption in the frozen state.

Background of the invention: The compositions of ice confections have developed over the years and a typical characteristic is the aeration of the composition. This
15 feature is referred to as overrun and is quoted as a percentage ie

$$\% \text{ overrun} = 100 \times \frac{\text{volume of product} - \text{volume of pre-aerated mix}}{\text{volume of pre-aerated mix}}$$

20 Levels of overrun maybe from about 20% to about 200% with the range for usual commercial products being from about 40% to about 150%.

25 The presence of a dispersed gas in the ice confection can lead to dimensional changes with change in ambient pressure. The ambient pressure will usually change as the ice confection is transported through a considerable geographic height difference or placed in an environment of
30 continuous low pressure, eg an aircraft. The volume changes will be proportional to the volume of gas dispersed as discrete cells.

 The effect of these dimensional changes can be apparent in
35 packaged ice confections, for example in the movement of tub lids, and coated products in which the continuous coating, for example fat containing couvertures, will crack as the dimensional changes are transmitted to it.

General description of the invention:

The applicants have found the use, as aerating gas for an ice confection, of a gas containing at least about 60%, preferably at least about 70%, by volume of carbon dioxide, nitrous oxide and mixtures of these gasses reduces the dimensional changes. The remainder of the gas will typically be a nitrogen containing gas, eg air. The resulting aerated ice confection will then be shaped, eg by extrusion followed by cutting or moulding. The aerated ice confection may be packaged in a tub for sale, but a preferred form has a continuous coating formed on at least one surface. Thus this continuous coating, preferably a fat based couverture, may be on the top surface of an ice confection in a tub or preferably envelopes the ice confection to give a product in bar form or on a stick, as examples.

The products to which the invention relates will have at least about 3% fat content, more preferably at least about 8% fat.

It is believed the use of these water soluble ingestible gasses leads to the formation of channels within the bulk of ice confection. That is, soon after manufacture the gas phase forms a substantially continuous network which allows movement of gas through the bulk for release at the surface of the ice confection. This is in distinction from a gas distributed in discrete bubbles throughout the bulk.

The aeration is preferably performed at a gas pressure in the range from about 0.25 to about 6 bar absolute pressure.

Literature: Ice confections have been well characterised in the literature. General disclosures will be found in Ice Cream by W S Arbuckle (4th edition published by AVI

company of Connecticut USA) and Manual of Ice Cream by B Crowhurst (published by J G Kennedy of London England).

Specific description of the invention:

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Examples of the invention will now be given to illustrate but not limit it with reference to the accompanying diagrammatic drawings in which:

- 10 Fig 1 shows the effects of aeration with air and carbon dioxide (100%),
- Fig 2 shows the effects of aeration with air/carbon dioxide mixtures,
- 15 Fig 3 shows graphs demonstrating the effect of overrun,
- Fig 4 shows the relationship between displacement and phase volume, and
- 20 Fig 5 shows the effects of aeration with nitrous oxide.

Example I

25 An ice cream composition containing

	% wt.
sucrose	17.00
butter oil	12.00
skimmed milk powder	7.00
30 stabiliser	0.70
whey powder	3.00
flavour (vanilla)	0.30
water	60.00

35 was prepared using standard procedures including a scraped surface heat exchanger. The overrun, at a level of 60%, was introduced by a standard method. The ice cream was

aerated with carbon dioxide (100%) at 0.5 and 4 bar freezer barrel pressure and both coated and uncoated products were tested.

5 The ice cream was extruded at -6°C and formed by moulding into blocks with the dimensions 25mm x 60mm x 100mm. It was then given a coating of standard couverture having a thickness of about 2mm by dipping.

10 Dimensional changes were measured by placing the sample, with large face uppermost, in a 25cm diameter desiccator positioned in a commercial ice cream freezer cabinet. A displacement transducer was positioned against the upper surface to that movement could be measured with time. The
15 pressure and temperature in the desiccator were monitored.

The products were kept in the desiccator at -15°C for several hours under atmospheric pressure. The pressure was then reduced by 200 millibar over 15 minutes, held at the
20 reduced pressure for 30 minutes and brought back to atmospheric over 15 minutes. The displacement in millimetres was measured over at least 2 hours. The displacement is shown in figure 1 in which the graphs are

- 25 A - aerated (CO_2) at 0.5 bar uncoated
B - aerated (CO_2) at 4.0 bar uncoated
C - aerated (CO_2) at 0.5 bar coated
D - aerated (air) at 4.0 bar coated (control)
E - aerated (air) at 4.0 bar uncoated (control)

30 These results show the displacements obtained with the present invention are considerably less than that obtained using air as the aerating component in controls D&E. The sudden increase in displacement at point x for the control coated product (D) is due to failure of the coating.
35 Additionally the maximum displacement of D is above that of E because of amplified leverage by the coating. Product C shows essentially no displacement.

Example II

The procedure of Example I was repeated for uncoated ice confections using a gas containing 75% by volume carbon dioxide and 25% air prepared with a freezer barrel pressure of 4 bar. The results are shown in figure 2 in which the ice confections of the invention (F) were compared with a control gas (G) containing 25% by volume carbon dioxide with 75% air. The pressure change regime of Example I was used. It is seen the ice confection of the invention (F) had a negligible displacement with change in pressure compared with control G.

Example III

The presence of channels in the aerated ice confection is demonstrated by reference to figures 3 and 4. Figure 3 shows the effect of overrun on the displacement (mms) measured as described in Example I. The graphs of the aerated ice confection prepared using air at 4 bar, are identified as:

	% overrun	phase volume
H	5	0.05
J	20	0.1
K	60	0.38
L	100	0.50

The phase volume is the proportion of gas phase in the total volume of product.

Figure 4 shows the relative displacement of the Fig 3 examples represented as the ratio compared with the original surface height as unity. This displacement is plotted against the gas phase volume. The straight line M results from the expansion of the unconnected gas phase bubbles expanding and transmitting these changes to the

surface by hydraulic pressure as the ambient pressure falls.

The line N is the displacement ratio of an ice confection of the invention prepared as described in Example I. The proximity of this line to the unity axis demonstrates that aerating gas must be lost through channels defining a continuous gas phase within the product.

Example IV

Example I was repeated using nitrous oxide/air mixtures at 4 bar freezer barrel pressure. The samples were uncoated and retained at -15°C for 5 days under atmospheric pressure, that is a longer period than the several hours used in Example I. During 5 days storage the 60% overrun reduced to about 40%.

Figure 5 shows the displacement/time graphs for the nitrous oxide/air mixtures. The pressure was reduced by 200 millibar over 15 minutes, held at the reduced pressure for 15 minutes and then brought back to atmospheric pressure over 15 minutes. The displacement was measured (in mms) over 70 minutes.

P	-	aerated with N ₂ O (95% vol)
Q	-	aerated with N ₂ O (75% vol)
R	-	aerated with N ₂ O (50% vol)
S	-	aerated with air

The results show a relatively dimensionally stable ice cream is obtained after loss of some of the aerating gas. Similar results were obtained with samples coated with 2mm of couverture.

Example V

5 Using a mixture of carbon dioxide and nitrous oxide (50% volume of each) gives dimensional stability substantially the same as described in previous examples.

Claims

1. A method of preparing an aerated ice confection containing from about 20% to about 200% overrun in which a confection composition is mixed with an aerating gas which contains at least about 60%, preferably at least about 70%, by volume of carbon dioxide, nitrous oxide and mixtures thereof and subjected to a freezing step.
2. A method according to claim 1 wherein the overrun is from about 40%.
3. A method according to claim 1 or 2 wherein the overrun is up to about 150%.
4. A method according to claim 1, 2 or 3 wherein the aerated ice confection is shaped and then has a continuous coating formed on at least one surface.
5. A method according to claim 4 wherein the continuous coating is a fat-based couverture.
6. An aerated ice confection prepared by the method of any preceding claim.