

# MILK SUGAR

A Natural Multi-Purpose Ingredient



**The benefits  
of using milk sugar  
in pastries  
and plain cakes**



# THE CONSUMER

## The many benefits of using milk sugar

### Milk Sugar in Bakery Products

Milk is good for consumers who care about a healthy and natural diet. Milk's positive image exceeds that of most other foods, and the same applies to the nutritious substances it contains. But consumers are also becoming increasingly more critical of food additives. Hence, the baking industry and outlet bakers and pastry-makers need to find solutions to the question of how to balance marketing and consumer demands, while maintaining accord between such measures and the necessary technology and keeping expenditures at a minimum.

At the end of the day, consumers are interested in the end product alone, purchased either straight from the ovens of a resident outlet or at the supermarket. It needs to be fresh, tasty and look delicious – qualities that are no less vital for the success of products manufactured using alternative processing methods and ingredients. The use of milk sugar (lactose) provides manufacturers with a whole range of benefit arguments that can be effectively used in advertising to appeal to consumers, in addition to which lactose is technologically simple to use.





# PREFERS THE TASTE TOO

## Natural and Healthy

The nutritional properties of milk sugar can be easily summarised and made comprehensible for consumers. Milk sugar is derived from whey, its basic substance. Whey is a milk by-product derived from the process of making cheese. By concentration of the whey and subsequent crystallization the raw milk sugar is obtained. The next step in the process is to refine and dry the milk sugar to the desired quality. We can describe milk sugar as being "a top ingredient of milk". Not only does its mild sweetness contribute to an ideal taste, but milk sugar is also an easily digestible source of energy. Since this natural product furthermore helps our body to absorb calcium, it strengthens our bones and teeth.

## Easy to Process

In addition to its nutritional value, milk sugar has properties that are very practical for processing. Manufacturers who totally or partially replace the usual sucrose with milk sugar will soon find that technical processing requirements need not be expanded. Quite the contrary is, in fact, true. Comprehensive research studies and practical testing by the Federal Centre for Cereal, Potato and Lipid Research, located in Detmold, Germany, have proven that the use of milk sugar in bakery products has significant technological and qualitative advantages. A welcome fact, from a marketing perspective, is that milk sugar is a natural ingredient and is not subject to labelling – a definite advantage in view of the fact that additives labeled on products often confuse critical consumers.

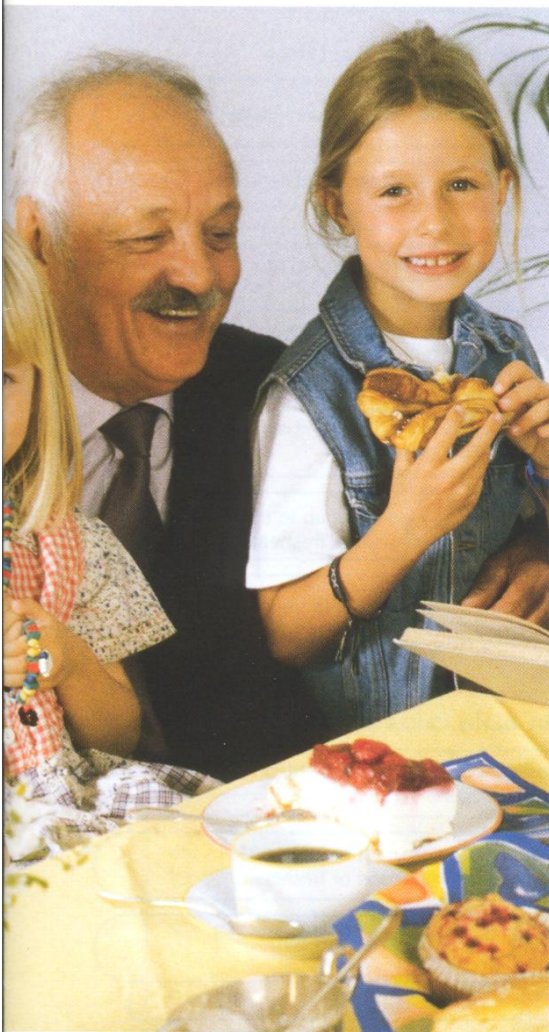


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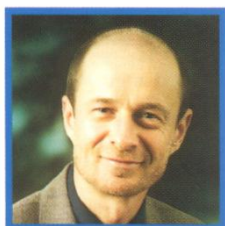
# BE IT IN SWEET-YEAST PASTRIES OR PLAIN CAKES...

## ...Milk Sugar is an Ideal Technical and Sensorial Ingredient

Depending on the type of product being processed, milk sugar has ten distinct advantages. Research has shown that the use of milk sugar has a general positive affect on the overall product throughout all the

stages of processing and storage.

This is due to its special composition, which distinguishes it from sucrose.



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Thanks not least to many years of research, we can now draw on a comprehensive pool of scientific knowledge and experience with respect to the use of milk sugar. Numerous types of bakery products have been examined (from meringue to croissants, fillings, biscuits, Danish pastries and gingerbread), so that we now have a variety of distinct findings on the affects of milk sugar. Based on such research, we know that milk sugar develops very special properties when used in sweet-yeast pastries and plain cakes, notably that it helps to maintain to the taste of such products and keeps them fresh for longer. From a practical standpoint, its use has both technical and sensorial benefits that requires no additional efforts.

But the use of milk sugar is beneficial also from an expenditures point of view. Just as diverse as its benefits is its product-innovation potential that offers those who use this ingredient both new and individual options. Not only will manufactures ultimately profit from this potential, but so will consumers.

Both types of sugar are so-called disaccharides, each consisting of two linked sugar molecules. The difference is that, whereas sucrose is the combination of a glucose with a fructose molecule, milk sugar consists of glucose and galactose. This combination, in contrast to that of sucrose, means milk sugar cannot be split into its single units of composition when subjected to baker's yeast enzymes. And this particular quality has a vital impact on the way milk sugar reacts technically.

This natural ingredient has seven practical benefits when used in sweet-yeast dough and the cakes and

pastries into which it is processed, and three benefits when used specifically for making plain-dough pastries such as muffins:

### A NATURAL MULTI-PURPOSE INGREDIENT

#### Used in sweet-yeast pastries:

- 1 it allows for larger dough and pastry yields,
- 2 dough requires less proof time and achieves improved proofing stability,
- 3 it has a positive affect on the function of flour,
- 4 it improves pastry volume and appearance,
- 5 it improves crumb consistency and softness and preserves freshness,
- 6 it achieves a reduction in fat of up to 50% without any loss in tastiness or freshness,
- 7 and it responds without the need for additives.

#### Used in plain cakes or muffins:

- 8 it reduces sweetness without effecting the cake characteristics,
- 9 it achieves a reduction in fat of up to 50% without any loss in tastiness or freshness,
- 10 and it allows a larger fat-reduced batter and pastry yield.

	Milk sugar	Sucrose
Fermentable with baker's yeast	no	yes
Solubility (g/100 g solution; 20°C)	15	65
Relative sweetness (%)	30	100

The technical and sensorial differences between milk sugar and sucrose (figures rounded off)



# MORE DOUGH MEANS MORE PASTRY

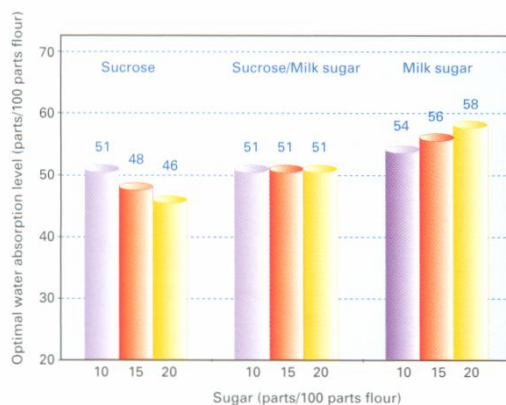
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**Dough that contains milk sugar can generate up to five percent more pastry yield than sucrose dough.**

This is due to the special qualities of milk sugar. Compared to sucrose, it has a relatively low solubility. Because milk sugar makes dough firmer, it can absorb more water than sucrose dough can. Studies have shown the exact consistencies in doughs that contain differing quantities of milk sugar or sucrose.

The additional yield through the absorption of higher fluid amounts is not lost through the baking process. Baking losses are comparable with those recorded for sucrose dough.



Optimal water amounts for sweet-yeast doughs with 10 parts fat and a variety of milk sugar and sucrose parts.



Optimal water amounts for rich fruit loaves with 15 parts sugar and 45 parts baking margarine, based on 100 parts flour.

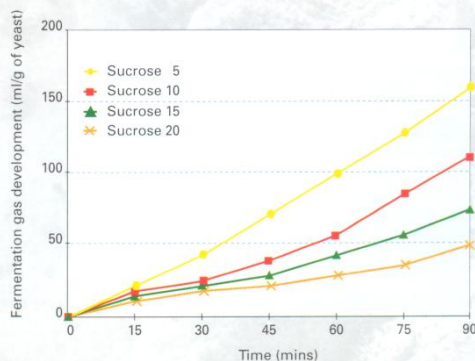
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## A MORE STABLE DOUGH AT REDUCED PROOFING TIMES

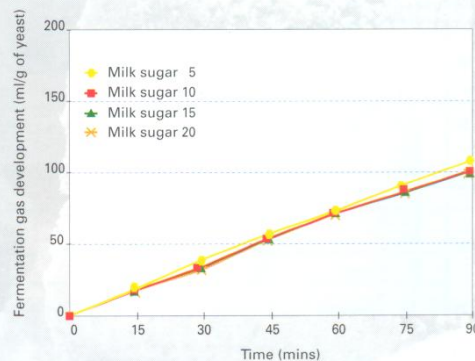
This affect, too, can be contributed to the relatively low solubility of milk sugar. Water activity thus remains at an extremely high level, even in doughs with large amounts of sugar and fat, which, in turn, allows for good proofing times. Since it is commonly known that a share of sucrose of more than three percent has a detrimental affect on fermentation, undissolved milk sugar does not have a retarding effect on yeast. The contrary is, in fact, true. The interaction of yeast and milk sugar is characteristic. Tests have shown that even special types of yeast with strong fermentation qualities cannot achieve the same effectiveness as milk sugar.

When completely replacing sucrose with milk sugar, one merely needs to use a type of flour with sufficient ready fermentable sugars in order to supply the yeast with enough of the nutrients that milk sugar cannot provide, since yeast cannot split and ferment it in its subunits. It is therefore generally advisable to replace 50 to 90 percent of the sucrose content with milk sugar, and thus remain free in the choice of flour and its individual fermentation characteristics.

**Milk sugar enables the fermentation process in the dough to be accelerated. It also gives the dough more stability and makes it ideal for rich fillings and toppings.**



Fermentation gas development in doughs with 5, 10, 15, 20 parts sucrose and 10 parts fat, based on 100 parts flour.



Fermentation gas development in doughs with 5, 10, 15, 20 parts milk sugar and 10 parts fat, based on 100 parts flour.

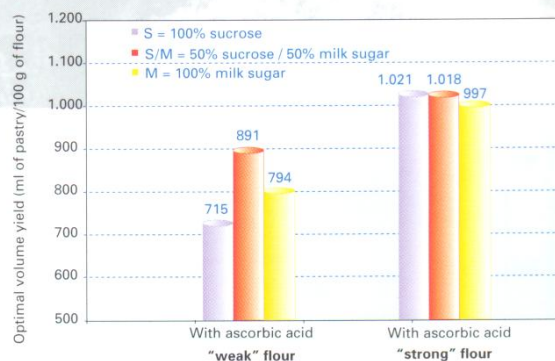


## GOOD RESULTS USING DIFFERENT FLOURS

3

**Milk sugar can enhance the suitability even of flours that are normally “too weak” for yeast doughs. The baking results can be just as good as those in which high-quality flour has been used.**

The positive effect of milk sugar on flour is demonstrable by replacing more than 50 percent of sucrose with milk sugar. The higher the content, the more evident will be the “flour-enhancing” effect. Pastry volume yields can thus be increased to levels normally achieved with very high-quality flour. From the point of view of proportionality, it is irrelevant whether commonly used emulsifiers such as diacetyl tartaric acid ester, mono- and diglycerides, or lecithins have been used. Even if a recipe does not include the use of emulsifiers, the milk sugar still has its beneficial effect on the flour, since this effect is due to the indirect reaction of the gluten protein contained in wheat flour.



Optimal volume yields depending on the use of milk sugar in combination with “weak” and “strong” flours with ascorbic acid and no emulsifiers. Doughs with 10 parts of sugar in total, based on 100 parts of flour. (Also see diagram on page 11.)

# 4

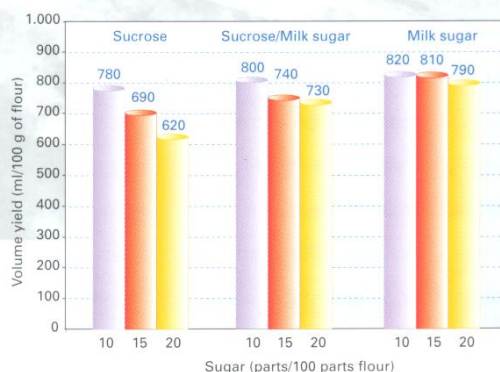
## IMPROVED SHAPE AND APPEARANCE

During the baking process, milk sugar has the effect of improving the rheological properties of the dough. Its expansivity is improved, it maintains stability and develops the characteristic type of crumb.

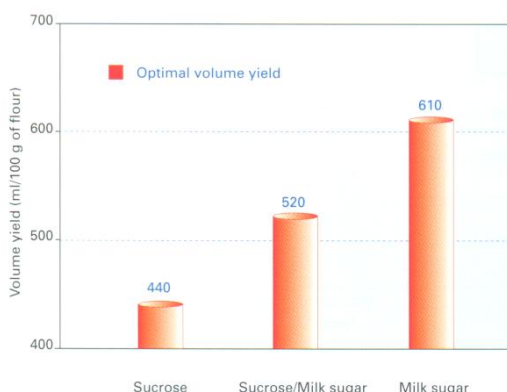
Milk sugar generally improves pastry shape and appearance, e.g. through the typical golden-brown colour of the crust.



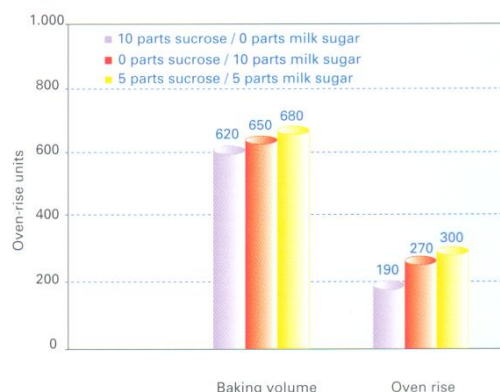
In contrast to sucrose, that dissolves completely within the dough, milk sugar only completely dissolves during the high-temperature process of baking. The dough thus retains for longer the elasticity it receives through the milk sugar. Hence, during the "critical" baking phase in which conventional baking ingredients can often cause the forming crumb to collapse, it has better gas-retention qualities and is better able to expand. Crumb forming and stability, and pastry volume are advantageously influenced. These effects become evident in the so-called oven lift.



Example of optimal volume yields in sweet-yeast dough with 10 parts fat and differing parts of milk sugar and sucrose.



Example of optimal volume yields in rich fruit loaves with 15 parts sugar and 45 parts baking margarine, based on 100 parts flour.



Results of oven rise for doughs with 10 parts sugar and 10 parts fat, based on 100 parts flour.



# SOFTER CRUMB, LASTING FRESHNESS

5



**Milk sugar delays “ageing”, i.e. it retards the staling and firming and retains an improved freshness of taste.**

This is due partly to the effect of milk sugar on the gluten protein in flour and the improved water-absorption capacity of the dough. When pasties appear dry this is not due solely to the possible evaporation of moisture, but rather chiefly to the reconversion of the starch which, in turn, results in the ageing of the crumbs and a loss of tastiness. The reconversion of starch, which is not contingent on a more or less strong depletion of moisture is retarded considerably by milk sugar.

If the crumb is to be especially sweet, sucrose should be additionally used, whereby a relatively low amount (five parts sucrose in proportion to the amount of flour) will suffice.

Recipe-Type	Normal Fat Amount				Reduced Fat
<b>Fat</b>	<b>10</b>				<b>5</b>
<b>Milk sugar</b>	<b>10</b>	–	<b>20</b>	–	<b>15</b>
<b>Sucrose</b>	–	<b>10</b>	–	<b>20</b>	<b>5</b>
Optimal water amount	50	48	54	43	52
Optimal volume yield	390	360	380	300	390
Penetration resistance after 1 day	155 (+/- 18)	175 (+/- 13)	92 (+/- 10)	275 (+/- 21)	100 (+/- 10)
Penetration resistance after 7 days	249 (+/- 22)	372 (+/- 46)	308 (+/- 16)	610 (+/- 57)	285 (+/- 20)
Overall freshness after 7 days	••	•	•••	•	•••

Water amounts (parts) based on 100 parts flour, volume yield based on 100 parts dough

Increasing figures for penetration resistance indicate that the firmness of the pastry crumb is increasing

Very good ••••• ← • Very poor

Figures in brackets indicate statistical standard deviations

# 6

## NO-COMPROMISE FAT REDUCTION FOR SWEET-YEAST PASTRIES

The combined use of milk sugar and sucrose can reduce the fat content in sweet-yeast pastries by up to 50 percent, without any reduction in tastiness – a very appealing fact for conscientious consumers who do not want to forfeit good taste.

Consumers often associate foods labelled “fat reduced” with the self-denial of excruciating diets, especially since an array of substances is often used to achieve fat reduction, causing the food to have a peculiar taste. However, anyone who tastes fat-reduced bakery products that contain milk sugar will be pleasantly surprised and will gladly choose such products again. Using milk sugar, fat contents can be easily reduced without the need to include additives. This is achieved by doubling the overall sugar content (including milk sugar). Depending on the relative proportions of the ingredients used in the dough, it can absorb more water and will remain smooth and stable, even with lower fat. For example: a dough with 50 percent fat reduction will contain three quarters milk sugar and one quarter sucrose. The ultimate consistency, pastry yield, appearance and freshness become evident in the end product. Because of the mild sweetness of milk sugar, the increased amount of sugar used is not discernible in the taste of pastries.

	Basic Recipe Using Sucrose	Fat reduced Recipe Using Milk sugar
Pure fat (parts)	10	5
Sucrose (parts)	10	5
Milk sugar (parts)	-	15
Approx. water (parts)	53	58
Approx. dough yield with “strong” flour	180	190
Volume yield (ml/100 g of “strong” flour)	900	930
Volume yield (ml /100 g of “weak” flour)	790	910
Pastry sweetness	Sweet	Sweet
Pastry freshness after 4 days	Slightly affected, a little firm	Perfectly fresh, a little soft
Approx. overall fat content in pastry	6 %	3 %

All parts based on 100 parts “strong” flour, 6 parts yeast, with a final proofing time of 75 minutes and 50% fat reduction in sweet-yeast dough containing milk sugar.



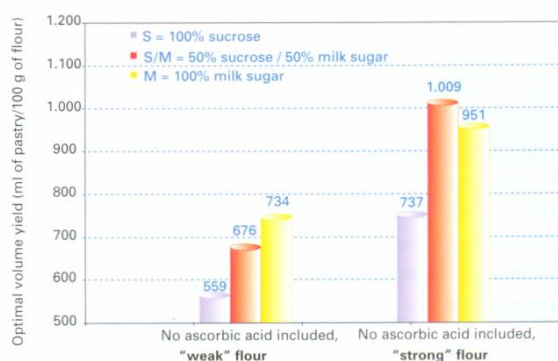


## A NATURAL INGREDIENT VERSUS ADDITIVES

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The production of foods that are either low in additives or, where possible, contain none whatsoever means complying with the wishes of consumers. But forfeiting the use of additives is also a technical challenge. Milk sugar meets both the demands for a natural product as well as those of efficient technology.

Some ingredients can't be used on their own. Using a basic substance A, for example, may require the inclusion of an additional substance B in order to achieve optimal results. This does not apply to milk sugar. Tried-and-proven recipes for sucrose-based sweet-yeast doughs can be easily modified without the end product requiring re-declaration. Under food laws, milk sugar is not considered an additive, so no restrictions exist with respect to its use (excepting its use in diabetic products). As a natural ingredient, milk sugar can even adopt the functions associated with additives. If, for instance, a type of pastry is to be labelled "no additives used", it may not contain any ascorbic acid, a substance which, however, is generally added to the flours used in yeast dough. The affect of milk sugar on the flour – as already described above – is the perfect solution. Ascorbic acid chemically influences the gluten protein in flour. Milk sugar has a physical influence, since, unlike sucrose, it is only contained in the dough in partially dissolved form. Thus, the gluten-protein network contained in the dough is not as weak as it is in a sucrose-based dough. But it is also possible to combine milk sugar with conventional additives.



Optimal volume yield contingent on the use of milk sugar and either "weak" or "strong" flour without ascorbic acid or emulsifiers. Doughs containing a total of 10 parts sugar based on 100 parts flour. (Also see diagram on page 7.)

# 8

## REDUCES SWEETNESS, BUT NOT THE TASTE



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Nowadays, milk sugar is an ingredient that is used in a variety of ways by the food industry. But it also has a very long history of use.

Milk sugar is an important nutritional carbohydrate found naturally only in the breast milk of humans and mammals. In our everyday diet, carbohydrates are predominantly a source of energy. But milk sugar, a disaccharide containing glucose and galactose, can do a lot more than just supply energy. The specific nutritional and physiological benefits of milk sugar in comparison to other types of sugar have repeatedly been proven during 50 years of research.

Findings show that milk sugar helps create an optimal gastro-intestinal environment. While milk sugar is a good medium for the natural germs resident in intestinal flora, it provides no nourishment for non-resident germs. It helps maintain a harmony of digestive activity and improves the intestinal resorption of calcium and other minerals, e.g. magnesium and zinc.

All these positive properties plus the many other benefits of this natural milk product are arguments in favour of using milk sugar in bakery products.



**Milk sugar can also be used in bakery products that are rich in sugar and fat, e.g. plaint cakes, to make them “lighter” and less sweet without changing the traditional character of the product. The only change is in the quantities recommended for the exchange of sucrose for milk sugar.**

In principle, conventional manufacturing procedures need not be altered.

In some individual cases, it is recommendable to reduce the baking temperature, since milk sugar may accelerate the crust-browning process. While sucrose can be entirely replaced by milk sugar for the production of sweet-yeast pastries, it is advisable to increase the milk sugar content by around one third for the production of plain-dough cakes and by no more than 50 percent for the production of cakes with a very high sugar content. This will result in a mild, slightly reduced sweetness. An additional advantage is that it produces no disagreeable taste peculiarities whatsoever of the kind normally perceived by consumers when certain sugar substitutes or artificial sweeteners are used.



## PLAIN CAKES WITH UP TO 50 PERCENT LESS FAT

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**A fat reduction of around 50% can also be achieved in plain cakes using milk sugar, so that such products can likewise be declared as fat reduced.**

When milk sugar is used in traditional recipes, no additional ingredients are needed to achieve a typical pastry appearance. There are, however, two minor differences in comparison to sweet-yeast pastries: fat reduction can lead to a slightly lower pastry volume if the relative proportions between fat and sugar are not perfectly balanced. When using milk sugar in plain cakes with a high sugar content (more than 120 parts sugar for 100 parts flour and starch), a portion of pregelatinised starch or pregelatinised flour needs to be taken in order to prevent the pastry crumb from becoming too dense. This only applies, however, in the event that significant amounts of fats are to be reduced.



# 10

## THE RECIPE FOR INCREASED RETURNS

**When producing plain cakes, a certain level of fat reduction coupled with a certain amount of sugar will enable pastry yields to be increased by up to six percent.**

The "trick" is to create a mixture that allows the water amounts in the dough to be significantly increased. The amount of water can be doubled if, for instance, one reduces the fat content of pastry by two thirds while at the same time increasing the overall amount of sugar by one third. The same applies for these types of pastries as does for sweet-yeast products: namely that the use of milk sugar prevents extreme sweetness of the cake.



Pastries that have been fat reduced by using milk sugar are recommended to be sold in as fresh a state as possible, since the relatively high water activity they contain reduces their microbiological imperishability (as is similarly the case with conventional fat-replacers).

This aspect is of no relevance for frozen bakery products. As far as appearance and taste go, milk sugar has the benefit that it retards the crumb-staling process and thus retains an appealingly fresh look.

	Plain-dough pastry, "Normal"		Plain-dough pastry, "High sugar"	
	basic recipe includes sucrose	fat-reduced recipe incl. milk sugar	basic recipe includes sucrose	fat-reduced recipe incl. milk sugar
Flour and starch (50/50%) (parts)	100	100	100	90
Pregelatinised starch (parts)	-	-	-	10
Baking margarine (parts)	60	20	60	20
Sucrose (parts)	80	46	120	80
<b>Milk sugar</b> (parts)	-	66	-	<b>80</b>
Egg (parts)	65	65	85	85
Water (parts)	15	23	25	50
Batter yield (parts)	325	325	395	420
Approx. increase in batter yield	-	0	-	<b>6 %</b>
<b>Approx. overall fat content in pastry</b>	19,2 %	<b>8,6 %</b>	16,7 %	<b>7,3 %</b>

3 parts whipping agents, 1,7 parts baking powder, 10% baking loss, 50% fat reduction for plain cakes made using milk sugar.



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