US patent 4,192,901 eventually discloses a method for manufacturing a concentrate defined as “milk-containing acid syrup” which is further used for preparing beverages by dilution with water. In this case, the inventors have addressed a specific issue, i.e. the stabilization of milk proteins by monitoring the casein / sugar ratio and subsequently subjecting the acidified milk-sugar mixture to ultra-high temperature heating: inventors have assumed that during said ultra-high temperature heat treatment, casein undergoes some form of reaction with sugar and, hydrophilic property of the casein is significantly enhanced.

US-A-3 996 391 discloses a syrup containing 3.0-5.0 wt% of cow milk, 3 times the weight thereof of sugar, and edible acid to yield a pH of 3.0-3.4. Said syrup can be diluted 3-4x to produce a soft drink having stable white turbidity when diluted with water. It is indicated that the addition of a stabiliser is not required.

Beverage dispensing machines or visual bowls are also quite popular in modern communities so they are frequently used for dispensing various kinds of beverages in cans or even as freshly prepared fruits juices or similar beverages. When refrigerated conditions like those which should apply to “ready-to-drink” milk based beverages are necessary, this is leading to use complex and expensive techniques or machines. Further, when working with milk based beverages hygiene is a critical factor.

An approach would be to allow preparation of such acidified milk based beverages immediately before consumption, for instance by storing separately sensitive or non compatible components like e.g. milk and acid or fruit juice and then mix them on demand. This way proved in fact unduly complex and expensive and, also, not suitable for use in conventional beverage dispensing machines.

An other way to by-pass the above difficulties or drawbacks would be using stable concentrated base compositions which would simply be diluted with water on demand, i.e. just before consumption. The art, unfortunately, does not provide today any appropriate solution to the skilled artisan.

The present invention offers an innovative and quite efficient solution to the skilled artisan while providing him a storable, shelf-stable, concentrated base composition which

already comprises all the ingredients necessary for preparing an attractive, acidified milk based beverage by mere dilution with water, namely by dilution in a beverage dispensing or vending machine.

Further features or advantages of the present invention shall appear in the specification here below.

Summary of the Invention

The present invention ~~primarily~~ refers to a method according to Claim 1. ~~a shelf-stable liquid base composition useful for preparing acidified milk based beverages, e.g. in beverage dispensers, said liquid base composition comprising:~~

~~from 2 to 10 weight % of denatured milk proteins expressed as solid-not-fat (SNF) milk components;~~
~~from 15 to 80 weight %, expressed as sugar equivalents, of a carbohydrate based and/or non carbohydrate based sweetener;~~
~~from 0.35 to 1.50 weight % of a carbohydrate based stabilizer; and~~
~~an acidifying agent present in amounts necessary for achieving a pH of 3.0 to 3.8 of the said base composition.~~

~~The invention further refers to a~~A method for preparing the said base composition~~, which method~~ comprises the sequence provided here below:

- heating a source of milk proteins at about 80 to about 120°C over a period of about 1 to about 20 minutes to achieve denaturising of the said milk proteins;
- mixing the source of denatured milk proteins with a carbohydrate based or non carbohydrate based sweetener and with a carbohydrate based stabilizer;
- bringing the above mixture to a pH of about 3.0 to about 3.8 while mixing it with an acidifying agent; and
- sterilizing or pasteurising the above acidified mixture and subsequently pouring it into containers.

~~The invention also refers to a~~Another method for preparing the said liquid base composition~~, which method~~ comprises the sequence provided here below:

- heating a source of milk proteins at 80 to 120°C over a period of 1 to 20 minutes in presence of a carbohydrate based or non carbohydrate based sweetener and of a carbohydrate based stabilizer;

- cooling down the heat treated mixture and bringing it to a pH of about 3.0 to about 3.8 while mixing it with an acidifying agent; and
- sterilizing or pasteurising the above acidified mixture and subsequently pouring it aseptically into containers.

The invention~~, eventually,~~ refers to a method for preparing acidified milk based beverages by dilution of the relevant liquid base composition with an appropriate amount of water and to the beverages so afforded as well.

In the acidified milk based beverage, the dilution of the liquid base composition with an appropriate amount of water refers to diluting one part of said base composition with 2 to 7 parts or water. Dilution can occur preferably in a beverage dispensing machine under controlled dilution conditions. Controlled dilution conditions may require the use of a pump for pumping the base composition at a certain flow rate and during a controlled time and a pump for pumping the water at another flow rate and during a controlled time and mixing said base composition and water in order to obtain the desired ratio.

The acidified milk based beverage is preferably delivered with a protein content of from 0.02 to 5% SNF and with sugar equivalent of from 7 to10 weight %. The beverage is also preferably delivered with a pH comprised between 3.6 and 4.2. A pH below 4.2 is preferred in order to guarantee a better machine hygiene. As a result of the base composition as designed, the acidified milk based beverage experiences physical stability for at least 1 hour after dispensing.

Detailed description of the Invention

One of the main characteristics of the invention consists in a well adjusted balance of selected ingredients and their proportions in the base composition, more precisely the milk proteins, a first class of carbohydrates such as sugars or sugar substitutes acting as sweeteners, a second class of carbohydrates acting as stabilizers like gums, pectins or the like acting as stabilizers and acid components. This adjusted balance provides the conditions necessary for stabilizing the base composition and the “ready-to-drink” beverage as well.

The use of this base composition represents another important feature of this invention. This shelf-stable milk base is designed for application in beverage dispensers such as e.g. visual bowls and juice dispensers. In both cases, the milk base offers convenience, ease of handling over ready to drink beverages and less hygiene concerns. For machine hygiene safety, the pH of the concentrate base composition and reconstituted beverage is designed to stay below 4.2.

The specific heat treatment of selected ingredients like milk proteins represents another feature of the invention as it is leading to denaturation of milk proteins to such an extent that they remain stable when subjected to subsequent treatments like acidifying, homogenising, pasteurising or the like and filling. Surprisingly, the stability of the base composition so achieved is further reflected in the "ready-to-drink" acidified milk base beverages, which are prepared by mere dilution with an appropriate amount of water.

According to the invention the liquid base composition comprises from 2.0 to 10-weight %, preferably from 3.6 to 6.0 weight % of denatured milk protein. Within the frame of the invention, proportions of milk proteins of are preferably expressed when referring to "solid-not-fat" or "SNF" milk components although simple weight percent may also be used to that purpose. In such a case 2.0 to10 weight % (SNF) would be equivalent to 0.7 to 3.6g of milk proteins in 100 grams of base composition. Weight percent are expressed as referring to the total weight of the base composition, i.e. the concentrate.

Suitable sources of milk proteins subjected to denaturing within the frame of this invention are conveniently selected form fresh and powder whole or semi skimmed or fully skimmed milk. Sodium caseinate, calcium caseinate, milk protein isolates, milk protein concentrates or whey proteins can also be used.

According to the invention the milk proteins have been denatured by heat treatment. Said treatment is generally performed by subjecting a liquid source of milk proteins at temperatures comprised between about 80 to about 120^{o}C, over a period of about 1 to 20 minutes depending on the manufacturing capabilities, preferably from 110 to 120^{o}C to a period of 2 to 5 minutes. The selected temperature and time conditions need to be addressed to achieve a degree of denaturation of at least 75%. The milk protein denaturing heat treatment may also be carried out as part of the processing for transforming liquid milk

Polysaccharides stabilizers are useful for achieving the desired viscosity and density and best results have been achieved in terms of viscosity range between 15 to 250 mPa.s, preferably, between 15 to 100 mPa.s of the base composition. It has been observed that physical stability of the base composition is also closely related to the viscosity value. In particular, when viscosity of the base composition is lower than 15 mPa.s, the base composition is not stable and milk solid tends to separate from serum and to settle at the bottom of container. Phase separation raises an important issue, in particular, for delivering beverages in a beverage dispenser where no regular stirring takes place and therefore quality of the final beverage can be dramatically affected with high milk solid content variations in the final beverage.

One feature of the invention lies in selecting the most adequate polysaccharide to be used as stabilizer. It has been surprisingly observed, however, that a level and type of stabilizer that allowed having a stable base composition did not necessarily provide a stable "ready-to-drink" beverage after dilution with water.

Therefore the goal of this invention is to provide stability for both the base composition and the final beverage and, furthermore, to select a stabilizer that does not increase the viscosity of the said base too much and that, at the same time, provides an acceptable mouth feel in the final beverage. The advantage of not increasing the viscosity of the composition too much is essentially that the composition can be pumped using conventional dispenser equipment and can be diluted easily at cold or ambient temperature while providing an homogeneously mixed beverage with water as a diluent, thus allowing to use these base compositions even with very simple beverage dispensers. Further, the amount of stabilizer used is dependent on the amount of milk proteins in the base; within the frame of this invention, the most suitable proportions of the carbohydrate based stabilizers (or polysaccharides) are comprised between about 0.35 to about 1.5 weight %, preferably from about 0.50 to about 1.00 weight %.

Eventually, the choice of the stabilizer is also directed by the pH of the base composition, as the selected stabilizer needs to remain fairly active and stable at pH range below 4, preferably from 3.0 to 3.8 during the whole processing and during storage over prolonged periods.

Among the various polysaccharides mentioned here above, i.e. gums, pectin or pectin derivatives, carrageenan or carrageenan derivatives or mixtures of same, guar gum, locust bean and sodium carboxymethylcellulose represents preferred stabilizers. When preparing a base composition having e.g. a SNF content of 3.6 weight %, of from 40 to 70 weight % of sugar equivalent concentration (which corresponds for example to 0.2 to 0.35 weight % of aspartame) and of high methyl ester pectin of about 0.4 and 0.7 weight % provide fairly stable base compositions; however, when the said base is diluted with water, solid particles tend to settle at the bottom of the container thus giving a beverage having an in-cup stability of max. 6 hours.

Best performances have been achieved by means of using high methyl ester pectin concentration ranging from 0.7 to 1 weight % and both the base composition and the final beverages exhibit the required stability and mouth feel.

Other polysaccharides such as acacia gum can be used at levels between 0.5 to 1 weight percent, proteins do not coagulate after acidification and a homogenous product was obtained.

Pectin or pectin derivatives like that mentioned above can also be combined with other hydrocolloids such as K-carrageenan, sodium carboxymethylcellulose and acacia gum: satisfying results have been obtained with both variants.

In particular, base compositions using non-sugar sweetener preferably require the use of a combination of pectin or pectin derivatives and another stabilizer having a thickening function in order to raise the viscosity of the base composition at or above 15 mPa.s. If only pectin is used, viscosity may not so be reached and a stability issue may be so appear. The additional stabilizer is preferably chosen in the group of K-carrageenan, sodium carboxymethylcellulose and acacia gum, guar gum and locust bean and combinations thereof.

Fat can also be present in the mixture subject to heat treatment mentioned here above. In order to avoid fat stability in the composition by fat migrating and forming fat globules at the surface of the liquid, it is also preferred that that fat is between 0.1 to 2% weight of the base composition. By fat it is meant milk fat coming from whole or semi skimmed

the consumption of a “ready-to-drink” beverage due to taste issues and most of the acidified beverages are usually consumed at a pH range of 4.0 to 4.4.

Thanks to the present invention this dilemma is conveniently solved by means of preparing a base composition the pH range of which can be lowered to an optimal level for the milk proteins, i.e. a pH of 3.0 to 3.5, without affecting the said milk proteins and by diluting it subsequently with the appropriate amount of water and so bringing the final beverage to pH between 3.6 and 4.2.

For applications with beverage dispensers and visual bowls, it is important that the concentrates or final beverages are kept refrigerated after opening and the pH of the product is below 4.2; therefore, below the pH range where pathogenic bacteria can grow. For best results, the pH of the concentrates is designed so that the pH of the final beverage is between 4.0 and 4.1.

Acidifying agents usable within the frame on the invention comprise edible organic acids such as e.g. citric, malic, tartaric or lactic acid. The selected acids are mixed with water in the ratio of about 30:70 and used to acidify the heated mixture of sugars, stabilizer, milk proteins and fat. Acidification is generally performed at 4°C and by adding the above mixture to the acid solution. This type of acidification is preferred because the milk proteins pass quickly below the isoelectric point around 4.6 and then stay in a pH range of below 4.

Acidification can also be performed by means of fruit juices/concentrates like apple, pear, lemon juice, orange juices, kiwi juice or exotic fruit juices to which acid content has been adjusted accordingly. When doing so the acidification further brings selected flavor components or vitamins. Of course artificial flavor components or minerals or micronutrients can also be added to the whole mixture.

Flavors and colorants are usually added to the mixture before final heat treatment, e.g. pasteurization. Nutrients like vitamins, minerals (Ca^{++} and Mg^{++}) etc. can be added at this stage without flavor and insolubility issues. In all cases, the dosage of these ingredients must be calculated based on the dilution factor to achieve the proper final beverages.