Making soy convenient

Soy milk has been part of the Asian diet for centuries and is becoming increasingly popular in other parts of the world, too, being perceived as a healthy alternative to cow's milk. However, as soy milk has traditionally been produced in small batches in small shops and with a short shelf-life, manufacturers need to look at new production methods if they want to match the needs of today's convenience seeking consumers. Using the UHT technology will allow for products with shelf-lives ranging from several months up to a year. Products that will be homogenous and have the right mouth-feel and creaminess, provided that they contain the right emulsifiers and stabilizers.

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Soy beverages have a history of over 5,000 years and are an important source of protein for many people, especially those who are lactose intolerant. Soy milk contains the same amount of protein as cow's milk, hence is often perceived as an alternative to dairy milk. Besides being a good source of protein, soy based foods are also known to provide numerous health benefits, such as:

- Lower in fat content, mostly unsaturated fat with zero cholesterol
- Naturally lower in sugar content than regular milk
- Contain only vegetable protein
- Fewer people allergic to soy than cow's milk
- Provide bone health
- Promote weight loss/control
- Prevent cancers
- Prevent cardiovascular disease

Fact: Soy drinks
Typically long-life, with a minimal amount of soy protein per serving. These products are positioned more as regular beverages (competing against soft drinks) rather than milk alternatives. Often, there is little or no information on soy protein content per serving. Black soy drinks have also recently emerged in Asia.

Countries such as China, Japan, Brazil, USA and Thailand all consume vast amounts of soy based products - and are likely to continue to do so. As indicated in tables 1 and 2 below, data from EuroMonitor International predict a very promising growth from 2013 – 2018, for soy milk as well as soy drinks. For 2013 alone soy drinks had a market size of US $ 2 601.4 million, for soy milk it was US $ 4 808.9 million. For a definition of soy milk and soy drinks, please see the fact boxes.

SOY MILK

Soy milk is the water extract from whole soy beans. It is an emulsion of fat in water containing water soluble proteins, carbohydrate and oil droplets. Soy milk has traditionally been produced by small shops daily in small batches. These are sold daily and have a short shelf-life. Here the soy beans were soaked, grinded, filtered and cooked.
Nowadays, a large part of the industrially produced soy milk is produced by means of the UHT process and aseptic filling, thereby obtaining a long shelf-life at room temperature. This puts a great demand to the stability of the product as a homogeneous product throughout the entire shelf-life is necessary for the consumer's acceptance of the product. To achieve this direct as well as indirect UHT systems may be applied. From a stability as well as from a sensory point of view direct systems are preferred. Direct systems result in less chemical changes in the product due to a lower total heat load and extraction of oxygen from the product in the vacuum chamber. The indirect system is, however, often preferred due to lower investment and running costs.

SOY DRINKS

Soy drink is a popular type of beverage in countries such as China, Brazil, Mexico, Malaysia and Argentina. It contains no less than 1.5 % in protein, and less than 0.5% fat with 5 – 15% sugar. Unlike soy milk (3 or more than 3% protein, 1 or more than 1% fat) which is known as non-dairy milk alternative, soy beverage is known as sweet nutritious drink consumed as soft drink.

Whichever UHT system is used, application of emulsifiers and stabilizers in soy milk and soy drinks is necessary. The products are emulsions of oil in water and for ensuring optimal emulsion stability, i.e. reducing creaming, during the entire shelf-life, not only proper homogenization but also addition of selected emulsifiers and stabilizers is necessary. Further, the stabilizers improve the stability of the proteins thereby minimizing sedimentation during storage of the soy product. The functionality of the emulsifiers and stabilizers are described below.

EMULSIFIERS FOR SOY BEVERAGES

Mono-and diglycerides of fatty acids are commonly used in soy beverages. Mono- and diglycerides are emulsifier produced by the reaction of vegetable fats and oil and glycerol. The end result is a molecule with ambiphilic properties, meaning part of the structure is hydrophilic while other moieties have a lipophilic nature and consequently it is placed at the interface between the fat/protein and water during homogenization, hence fat separation is reduced. When used in multiphase systems, the emulsifier will take a position which is favourable with respect to energy and minimizing coalescence of the fat globules.

Table 1:
Countries with a large market size in 2013 for soy drinks
(Source EuroMonitor International)

Name of country	Market size for 2013, US $ mn	Per Capita for 2013, US $	Forecast Growth 2013- 2018 CAGR
China	1 166.6	0.9	5.0%
Brazil	787.7	4.0	6.9%
Mexico	187.1	1.6	4.1%
Malaysia	124.8	4.3	3.4%
Argentina	107.0	2.6	5.1%

Table 2:
Countries with a large market size in 2013 for soy milk
(Source EuroMonitor International)

Name of country	Market size for 2013, US $ mn	Per Capita for 2013, US $	Forecast Growth 2013- 2018 CAGR
Japan	1 056.3	8.3	2.8%
USA	746.3	2.4	- 5.3%
Thailand	403.6	5.9	7.0%
South Korea	367.1	7.3	3.4%
Spain	209.8	4.6	- 4.1%
United Kingdom	201.7	3.2	0.4%
Brazil	184.0	0.9	1.3%
Australia	174.2	7.5	2.6%
Canada	172.1	4.9	- 1.3%
France	160.6	2.5	1.2%

Fact: Soy milk
Positioned as milk alternatives. Soy milk is typically fresh/pasteurized, found in chiller compartments, and contain a significant amount of soy protein per serving. Leading brands such as Silk (White Wave) contain 6 grams of soy protein per serving (approximately 250ml) or 2.4 grams per 100 ml. Other brands such as Alpro Soja (Vandemoortele International NV) contain 2 grams of soy protein per 100 ml. Vive Soy (Leche Pascual) contains 3.3 grams of soy protein per 100 ml serving.
Source:
Euromonitor International

STABILIZERS FOR SOY BEVERAGES

Stabilizers are water-soluble polysaccharides extracted from land or marine plants or from microorganisms. Adding stabilizers helps create the network required to suspend particles, increase viscosity, and improve mouth-feel. They are used for thickening and stabilizing properties. There are many types of stabilizers available which are unique in their own way:

Carrageenan, which is derived from red seaweed, is commonly used as a stabilizer in soy milk. The carrageenan forms a helix with negatively charge sulphate group. Carrageenans are grouped into kappa, lambda and Iota carrageenan according to their chemical composition. To achieve the best results while using carrageenan, the filling temperature will have to be less than 25 °C in order to form the carrageenan network. This network wills lose its gel strength if subjected to high temperature.

Microcrystalline cellulose (MCC) is becoming increasingly polpular as a stabilizer in chocolate beverages. MCC is derived from plant fibres and is often used in combination with carrageenan for synergic effect. With shear, MCC forms a three-dimensional matrix and is not affected by temperature.

When suspension of particles is required, gellan gum is often used. Gellan gum is produced by fermentation of algae. There are two types of gellan gum namely high acyl gellan gum and low acyl gellan gum. Gellan gum form gels in which particles are trapped.

Pectin, mainly extracted from citrus peels is often used in low pH beverages. They are used as a gelling agent, thickening agent and stabilizer in food.

THE CHALLENGE OF CHOCOLATE SOY DRINKS

The challenge in getting a stable and uniform soy product lies in choosing the right emulsifier and stabilizer blend (E/S), especially in chocolate soy beverages. Under-dosing / unsuitable E/S will cause sedimentation whereas over-dosing will cause separation and/or gelation. Numerous factors have to be taken into consideration when using any E/S blends: The % of total solid, % of fat, % of protein, % and type of cocoa powder used all have some effect on the end product. Beside that, the type of heat treatment plays a part too: Pasteurization, ultra high temperature (UHT) and retort are the three common types of heat treatments used on soy beverages. Least heat is used in pasteurization hence the shorter shelf-life of the product. Retort will be the harshest heat treatment to soy beverage. The dosage of E/S need to be adjusted according to the type of heat treatment to be used.

Creating a stable chocolate soy beverage is more difficult than a chocolate milk as it contains more fibres. By using a standard carrageenan system, the network will be not good enough to hold the cocoa particulates. A microcrystalline cellulose or gellan gum system will help in creating the network required for such application. Other factors such as filling temperature will also have an effect on the stability of the end product. Palsgaard has developed E/S solutions for filling temperature suited for both below and above 30 °C . In addition to the neutral pH soy beverage (see recipe suggestion in figure 1), we also have created an acidified soy drink with a low pH of around 4.0 (see recipe suggestion in figure 3). A refreshing soy drink that can be flavoured with juice concentrate such as orange, apple, mango and many others depending on local tastes and preferences. As it is a low pH beverage, please note that the heat treatment must be set to 110 °C / 4 sec, as low pH and high heat treatment will cause protein to be precipate out.

INTEGRATED BLENDS OF EMULSIFIERS & STABILIZERS

Palsgaard provides blended and integrated emulsifiers and stabilizer for use in soy beverages. In integrated blends emulsifiers and stabilizers are mixed and spray crystallized. This offers a number of advantages during production, such as:

- No dust formation during handling
- 100% uniform composition
- Dispersible at low temperature
- No pre-blending necessary
- Free flowing properties

EXTENSIVE APPLICATION SERVICE

Palsgaard has well-equipped application centers in Denmark, Singapore, Mexico and China that enable us to work on creating the right blends for any given market taking soy milk quality, recipe, process conditions as well as sensory preferences into consideration. Our equipment enables us to work with as well pasteurized, UHT-treated as sterilized products and to make shelf life studies covering the entire shelf life of the soy beverages. As a starting point, we often use recipe suggestions such as those shown in figures 1 - 3, which we then tailor together with the customer to meet their exact requirements.

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Figure 1:
Recipe suggestion for soy drinks with neutral pH

Palsgaard® RecMilk 122	0.20%
Soy base (5% protein, 2% fat)	45.00%
Sugar	2.00%
Water	52.80%
Composition of solids	
Fat	1.00%
Protein	2.25%
Total solids	11.00%

Figure 2:
Recipe suggestion for chocolate soy milk with neutral pH

Palsgaard® RecMilk 131 or Palsgaard® ChoMilk 173	0.20%
Soy base (5.6% protein, 2.8% fat)	53.60%
Sugar	6.00%
Cocoa powder	0.80%
Water	39.40%
Composition of solids	
Fat	1.50%
Protein	3.00%
Total solids	13.00%

Figure 3:
*Recipe suggestion for acidified soy drink with low pH**

Palsgaard® AcidMilk 372 or Palsgaard® AcidMilk 374	0.40%
Soy base (5.6% protein, 2.8% fat)	22.00%
Sugar	8.00%
Juice concentrate**	6.00%
Water	63.60%
Composition of solids	
Fat	0.60%
Protein	1.20%
Total solids	13.00%

** To add citric acid solution for targeted pH*

*** Please note when processing the acidified product, to cool down the stabilizer solution to less than 25 °C before adding the soy base and juice concentrate (to prevent precipitate of protein).*