

# Production of functional non-alcoholic drinks based on cereals

## Introduction

Interest in innovative non-alcoholic drinks is increasing rapidly as part of the trend towards more health-conscious nutrition. Drinks based on malt or cereals contain only natural sugar and are excellent sources of antioxidants, vitamins and other health-promoting substances.

The characteristics of these cereal-based products can be varied widely by using different functional constituents (Table 1).

tolerated by allergy sufferers.

Moreover, innovative flavours can be created by fermenting the extract with micro-organisms. Organic acids resulting from fermentation give the drink a fresh, fruity note, rather like lemonade. The fermentation products also create a feeling of wellbeing and stimulate the metabolic system.

On the following pages you will find detailed information on our SternEnzym products, their mode of action and their applications.

Functional constituent	Purpose	Principle of action	Product
<b>Enzymes</b>	Sweetening Viscosity Mouth feel Digestibility	Starch breakdown Pentosan breakdown Glucan breakdown Protein breakdown	Optizym BA Optizym HC Optizym BP Optizym GA Optizym A Betamalt
<b>Hydrocolloids Emulsifiers</b>	Vegetable cream Sport drinks Flavour Shelf-life	Particle suspension Fruit mix Oil emulsion Water binding	Stabimuls VEGA Stabisol BMJ
<b>Micro-organisms</b>	Prebiotics Flavour Fragrance Natural preservation	Gluconic acid Glucuronic acid Lactic acid Acetic acid	Quickferm product group

## Production of cereal drinks with the enzyme series *Betamalt* and *Optizym*

The production of cereal drinks is very much like the production of beer mash from malt.

But the use of malt alone means restricting oneself to the commercially available rye, wheat and barley malts. Other interesting cereals like maize, rice and oats, which are popular in Asia, are rarely available on the market in malted form (Table 2).

Nevertheless, the use of enzymes makes it possible to produce innovative cereal drinks from these grain types too.

**Tab. 1: Adjustment of cereal drink characteristics with SternEnzym products**

Cereal drinks are based on a suspension of grain. The viscosity, mouth feel and sweetness of the drink can be adjusted precisely to the customer's taste with enzyme compounds. An extract of this kind can already be drunk as a food supplement, but sifting and filtering of the extract open up further possibilities of creating interesting drinks. The filtrate from the extract, also called the wort, can be mixed with juices to make a sport drink rich in dietary fibres. The addition of oil emulsions to the wort produces drinks similar to milk or cream but without animal protein, lactose, gluten or soy constituents. Because of these properties, "cereal milk" is very well

Cereal	Starch in %	Dietary fibres in %	Protein content in %
Barley	53-57	11.9	9.8
Oals	52-53	11.9	12.0
Maize	58-63	12.4	8.5
Rice	70-74	3.6	7.2
Rye	53-58	14.3	8.8
Wheat	57-62	9.3	10.9

**Tab. 2: Starch, dietary fibre and protein content of various cereal types [3, 4]**



### Adjustment of viscosity and mouth feel in the liquefaction phase

The very finely ground grain is mixed with water into a mash. The mash is then heated in order to dissolve the starch and prepare it for enzymatic liquefaction and saccharification (Figure 2). It must be remembered here that different temperatures are needed for each cereal type in order to ensure complete gelatinization of the starch (Table 3).

Starch source	Dissolved starch in % of total starch		Gelatinization temperatures (°C)
	60 °C	65 °C	
Barley	92.8	96.2	56-62
Oats	92.5	93.4	56-62
Maize	18.5	54.6	62-72
Rice	17.1	50.4	61-78
Rye	91.7	94.5	57-70
Wheat	91.1	94.6	53-65

Tab. 3: Degrees of gelatinization of various cereal types at different temperatures [2, 4]

The  $\alpha$ -amylase Optizym BA is added to liquefy the mash further. This enzyme attacks the amorphous structure of the starch, hydrolyzes the  $\alpha$ -1,4-glycosidic bonds of amylose and amylopectin at arbitrary distances and releases water-soluble dextrans. By adding further enzymes such as the hemicellulase Optizym HC and the protease Optizym BP it is possible to adjust the mouth feel and digestibility of the cereal drink.

### Products for adjusting viscosity, mouth feel and digestibility

Optizym BA is a highly active bacterial  $\alpha$ -amylase that reliably hydrolyzes the gelatinized starch into dextrans even at high temperatures. Hydrolysis of the starch reduces the viscosity of the mash and prepares the starch for saccharification. It also prevents an unsightly sediment of re-crystallized starch from forming in the retail pack.

Optizym HC is a hemicellulase for adjusting viscosity. Pentosans and  $\beta$ -glucans are non-starch polysaccharides that bind water and are only partially soluble. They cause an increase in the viscosity of the wort. Optizym HC contains  $\beta$ -glucanase and pentosanase in a specific composition. The enzyme mixture serves as a tool for adjusting viscosity and thus for defining the mouth feel.

Optizym BP is recommended for grain with a high protein content. At the cooking temperature the high-molecular proteins become denatured and settle on the walls of the equipment or cause cloudiness in the drink.

The bacterial protease Optizym BP breaks the proteins down before they can become denatured and thus improves their digestibility too.

### Adjustment of the sweetness profile during the saccharification phase

In the subsequent step the mash liquefied by the  $\alpha$ -amylase is cooled to 60°C and saccharified to the required level by means of various enzymes (Figure 2). The choice of the enzymes used determines the percentages of the different sugars in the end product.

Betamalt releases chiefly maltose and maltotriose from dextrans. The glucoamylase Optizym GA, on the other hand, hydrolyzes dextrans into glucose. Through the combination of these enzymes the cereal drink acquires a sweetness which can be adjusted optimally in respect of its perception and intensity.

Besides the intensity of the sweetness (Table 4), the length of perception is characteristic of certain sugars (Figure 1). Perception of the sweetening power of glucose reaches its maximum intensity after only 5 seconds and disappears after 9 seconds, whereas maltose is perceived as sweet for as long as 16 seconds. These properties can be used for partially masking other tastes and thus for rounding off the flavour of the drink.

Sugar	Sweetening power (%)
Fructose	120
Saccharose	100
Glucose	69
Glucose syrup	40
Maltose	35
Lactose	27

Tab. 4: Sweetening power of various sugars (10 % aqueous solution, 20 °C) [1]

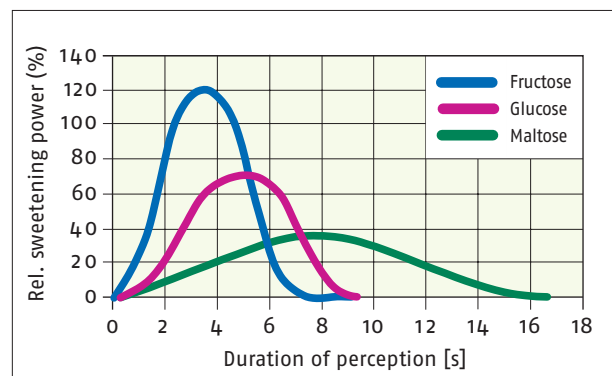


Fig. 1: Intensity profile of the sweetness of various sugars. The sweetening power is relative to a 10% saccharose solution (20 °C) [5]



## Products for adjusting sweetness

*Betamalt* offers optimum liquefaction and saccharification in a single product. *Betamalt* is a highly active barley malt extract and therefore of vegetable origin. Its main activity is  $\beta$ -amylase, which efficiently hydrolyzes dextrans into maltose. With *Betamalt* the maltose concentration can be increased to 60% of the total sugar content, and in combination with *Optizym A* it can even be raised as far as 80%. This gives the drink a mild sweetness.

*Optizym GA* for glucose formation. In brewing and distilling, glucoamylases like *Optizym GA* are used to ensure rapid saccharification of the mash. *Optizym GA* splits off glucose, starting from the non-reducing end of the dextrans. The formation of glucose alone results in a rapidly increasing sweetness.

*Optizym A* to prevent starch haze. This fungal  $\alpha$ -amylase splits any remaining starch residues into readily soluble dextrans and hydrolyzes these further into maltose. Viewed in isolation, the enzyme's sweetening power is only slight, but *Optizym A* speeds up the effect of *Optizym GA* and *Betamalt*.

The use of enzymes for saccharification of the mash makes it essential to pasteurize the drink in order to deactivate the enzymes and prevent changes in the product during storage.

## Overview of the enzyme products

Product	Liquid	Powder	Typical dosage*	Optimum pH	Optimum temperature
Optizym BA 19180 L	•	•	0.03–0.06 %	pH 5.0–6.0	60–65 °C
Optizym BA 6100		•	0.15–0.3 %	pH 5.0–6.0	60–65 °C
Optizym HC 19490 L	•		0.1–0.2 %	pH 4.5–5.0	55–60 °C
Optizym HC 184446		•	0.1–0.2 %	pH 4.5–5.0	55–60 °C
Optizym BP 17206 L	•		0.08–0.25 %	pH 6.5–7.0	55–60 °C
Optizym BP 18202		•	0.05–0.15 %	pH 6.5–7.0	55–60 °C
Optizym GA 14400 L	•		0.25–0.5 %	pH 4.0–5.0	55–60 °C
Optizym GA 5071		•	0.2–0.4 %	pH 4.0–5.0	55–60 °C
Optizym A 14125 L	•		0.2–0.4 %	pH 4.5–5.5	50–55 °C
Optizym A 16126		•	0.2–0.4 %	pH 4.5–5.5	50–55 °C
Betamalt 125 L	•		0.05–0.1 %	pH 4.5–5.5	55–65 °C
Betamalt 25 FBD		•	0.2–0.4 %	pH 4.5–5.5	55–65 °C

\* Relative to the amount of grain

[1] Lebensmittelchemie; Werner Baltes; Springer; 2000. [2] Stärke und Stärkederivate; Günther Tegge; Behr's Verlag; 1984. [3] Die Zusammensetzung der Lebensmittel – Nährwerttabellen; Souci, Fachmann, Kraut; medpharm Scientific Publishers Stuttgart; 2000. [4] Getreide- und Kartoffelbrennerei; Heinrich Kreipe; Verlag Eugen Ulmer; 1981. [5] FECHNER-Skalierung der Süßintensität und Vergleich verschiedener Methoden zur Bestimmung der Unterschiedsschwelle; Hoppe, K.; Ernährungs-forschung Vol. 36, Nr. 3, Seiten 81–83; 1991

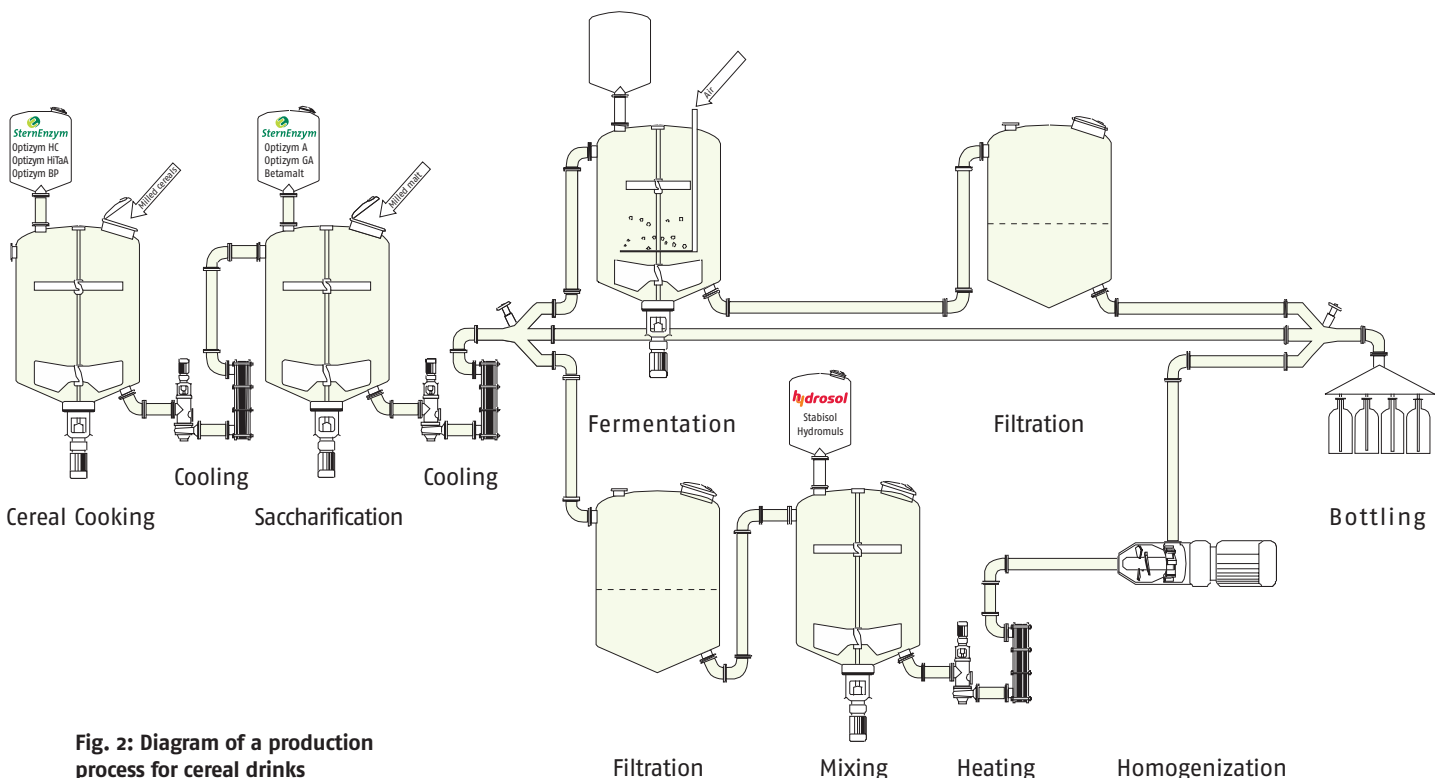


Fig. 2: Diagram of a production process for cereal drinks

## Stable products with hydrocolloids and emulsifiers from Hydrosol



Combined with juices or as an emulsion with vegetable oils, *cereal drinks* open up numerous possibilities for innovations and functional beverages.

The scope for innovation is widened still further by stabilizers specially adjusted for use in such novel applications. The following is a description of two stabilizer compounds with particularly good potential for this purpose.

*Stabimuls VEGA* is the name of a family of products from the range offered by Hydrosol, one of SternEnzym's sister companies.

*Stabimuls VEGA* is a perfect mix of emulsifiers and thickeners which can be used for combining cereal drinks with vegetable fat to make vegetable cream. By choosing specific *Stabimuls VEGA* products it is possible to produce vegetable creams for whipping or cooking; they offer important advantages over conventional dairy cream in respect of economy and processing technology. Moreover, they are free from the allergens dairy cream contains.

*Stabisol BMJ* is a compound of various stabilizers which makes it possible to produce a stable flavoured beverage from juice and cereal drinks. Rich in dietary fibres and with a high, rapidly available fruit sugar content, this drink is ideal for physically active people and athletes.

## Cereal drinks fermented with micro-organisms as an innovation

Fermentation of the sugar released by the enzymes results in flavour-active substances and organic acids; when combined, these create fruity, dry or slightly acid flavours.

The organic acids have the additional function of natural preservatives. Micro-organisms often used for fermented drinks include:

The bacterium *Gluconobacter oxidans*, which forms acetic acid, gluconic acid and glucuronic acid. These acids stabilize the drink against microbial attack, stimulate bowel activity, suppress putrefactive bacteria and are one of the components of detoxification reactions in the liver.

The brewer's yeast *Saccharomyces cerevisiae* metabolizes various sugars mainly into alcohol, but also into other flavour-active substances.

*Lactobacillus species* synthesize a large number of flavour-active substances and also lactic acid, which supports the intestinal flora and is considered a prebiotic.

The tea fungus or kombucha fungus is a symbiotic community of the above micro-organisms and certain others.

We will be pleased to give you detailed information on our micro-organisms from the **Quickferm product group**. Please contact us.



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