

## Product Description

Distizym® BA-TSA<sub>cid</sub> is a special enzyme for the liquefaction and dextrinisation of starch in distilling mashes from farinaceous raw materials. The enzyme is produced by a genetically modified strain of *Bacillus licheniformis* (host), the amylase coding genome was transferred from a strain of *Bacillus stearothermophilus* (donor). The main enzyme activity is based on a particularly thermostable, extremely acid tolerant  $\alpha$ -amylase (1,4- $\alpha$ -D-glucan-glucanohydrolase: EC.3.2.1.1). Distizym® BA-TSA<sub>cid</sub> is tested by specialized laboratories for purity and quality.

## Aim of treatment

Liquefaction and dextrinisation of the gelatinised, digested starch in distilling mashes within a temperature range of 50-105 °C, i.e.:

50- 70 °C at a pH range of pH 4.8-6.2,

75- 85 °C at a pH range of pH 5.3-7.2,

95-105 °C at a pH range of pH 5.8-6.8.

Under ideal pH conditions, Distizym® BA-TSA<sub>cid</sub> tolerates temperatures up to 110 °C for a short time.

## Product and Effect

As endo enzyme Distizym® BA-TSA<sub>cid</sub> hydrolyses 1,4- $\alpha$ -D-glycosidic bonds within the starch molecule. Products formed hereby are  $\alpha$ -limit dextrans and oligosaccharides.

## Dosage

The following standard dosages are recommended:

80 mL Distizym® BA-TSA<sub>cid</sub>/tonne starch from barley, wheat, rye,

100 mL Distizym® BA-TSA<sub>cid</sub>/tonne starch from corn, rice,

200 mL Distizym® BA-TSA<sub>cid</sub>/tonne starch from potatoes.

When the enzyme is used to dextrinize distilling mashes which were liquefied by high pressure cooking process, the lower amounts are applied.

## Application

### Traditional digestion of starch without pressure

Distizym® BA-TSA<sub>cid</sub> is dosed into the mash tank after doughing in, respectively milling in the raw material. Prior to addition the enzyme is diluted with cold water in the ratio of 1:1. The enzyme dilution is then added before or at the start of the heating phase. The liquefaction effect of Distizym® BA-TSA<sub>cid</sub> sets in when a temperature of 50 °C has been reached and at 60 °C and above liquefaction is highly efficient. Dependent on heating rate, a liquefaction rest period has to be kept, depending on mash pH, when reaching the final temperature of 80-100 °C. In general, a correction of the pH-value of the mash is not required. For enzyme activation it is recommended to add calcium (in form of Ca(OH)<sub>2</sub>, CaCl<sub>2</sub>, etc.) in amounts of 25-75 ppm related to pure calcium.

### Special digestion methods of starch without pressure (Hohenheim dispersion mashing method, etc.):

The whole required amount of Distizym® BA-TSA<sub>cid</sub> is added - diluted with cold water - into the mash dispersion tank before the mash is transferred in, or it is added to the decanted thin spent wash from the distillers' wash recycling. The thin spent wash should have a pH-value of at least 5.0, otherwise the pH-value must be raised. For the activation and stabilisation of the enzyme a calcium content of 25-75 ppm, related to pure calcium, is recommended. If the calcium content is below that value, then calcium should be added in form of Ca(OH)<sub>2</sub>, CaCl<sub>2</sub>, etc. During the transfer of the coarsely milled raw materials into the mash dispersion tank the gelatinisation of starch is done by continuous injection of steam while, at the same time, the mash is disintegrated by a dispersing machine for optimal starch release. The time for mashing in to obtain the desired degree of disintegration - controlled by hydrosizer - depends on the sizing of the dispersing machine, the degree of milling and the digestion method/conduct of the mash.

The enzymatic liquefaction already starts at a temperature of 50 °C, the final temperature of the process is at 90-95 °C. At that temperature also the liquefaction rest takes place. After reaching the desired degree of liquefaction the further dextrinisation and saccharification of the starch is conducted by Distizym® AG or Distizym® AG ALPHA, a possible protein hydrolysis and mash viscosity reduction is performed by Distizym® PROTACID and Distizym® GL as of 65 °C after cooling down.

Traditional High Pressure Cooking Methods (Henze-cooker, low-temperature methods, etc.):

After blowing out Distizym® BA-TSA<sub>cid</sub> is added - diluted with cold water - directly into the hot, gelatinised and digested mash. The liquefaction rest is recommended at a temperature range of 90-95 °C. It is furthermore recommended to add 25-75 ppm calcium, related to pure calcium, to activate and stabilize the enzyme. Generally a correction of the pH-value of the mash is not necessary. However, in case of longer liquefaction rest periods above 90 °C it is recommended to adjust the mash to a pH-value > 5.8 (see also „Aim of treatment“). When processing potatoes the methanol content of the distillate can be significantly reduced, if the liquefaction of the mash is carried through at a pH-value below pH 5.2 and at liquefaction temperatures of maximally 85 °C.

Special pressure/thermo methods (Jet-Cooker-method, High Pressure Cooking Method according to Michurin etc):

Distizym® BA-TSA<sub>cid</sub> is diluted with cold water and added continuously. In case of the Jet-Cooker method the diluted enzyme is added in two portions: at the beginning of the heating phase and at the exit of the Jet-Cooker. When the High Pressure Cooking Process (at 5-6 bar respectively 150-160 °C) is used, the diluted enzyme is added after pressure release in the steam separator during the cooling down phase, dependent on the method, already as of temperatures of 110 °C, in case of HPCP by dosing into the saccharification vat when the mash is transferred in. For every process, temperature and pH-value of the mash have to be adjusted accordingly (see also „Aim of treatment“). For the activation and stabilisation of the enzyme a calcium content of 25-75 ppm, related to pure calcium, is recommended.

## Storage

Optimum storage conditions at 0-10 °C. Higher storage temperatures result in a shorter shelf life. Temperatures above 25 °C must be avoided. Reseal opened packagings tightly and use up as soon as possible.

## General Characteristics

Enzyme characteristics: the activity range of the enzyme is between pH 4.0 and 8.0, the optimum is at pH 5.5-6.0 in the presence of substrate and calcium. The temperature ranges between 50-105 °C (max. 110 °C), the optimal temperature is within the range of 80-100 °C (max. 110 °C), dependent on the pH-value of the mash in the presence of substrate and calcium.

The diagrammes 1 and 2 show the influence of temperature and pH-value on the enzyme activity of Distizym® BA-TSA<sub>cid</sub>.

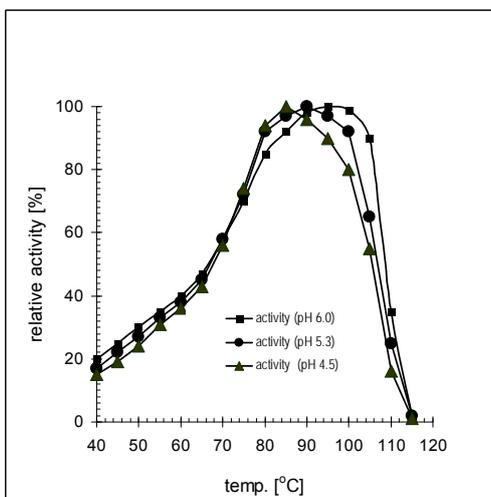


Fig 1: Influence of temperature on amylase-activity (10 % soluble starch).

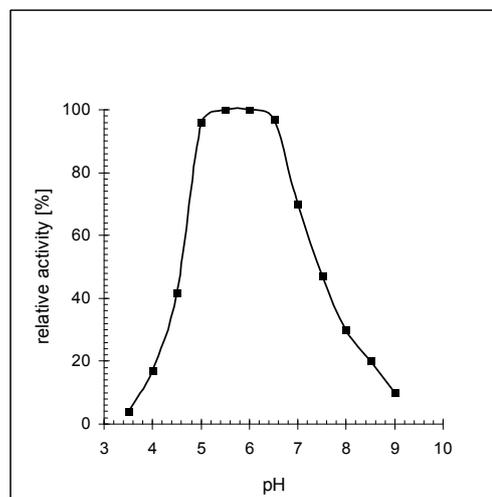


Fig 2: Influence of pH-value of the amylase-activity (10 % soluble starch, 90 °C).

The diagrammes 3 and 4 show the influence of temperature and pH-value on the enzyme stability of Distizym® BA-TSA<sub>cid</sub>.

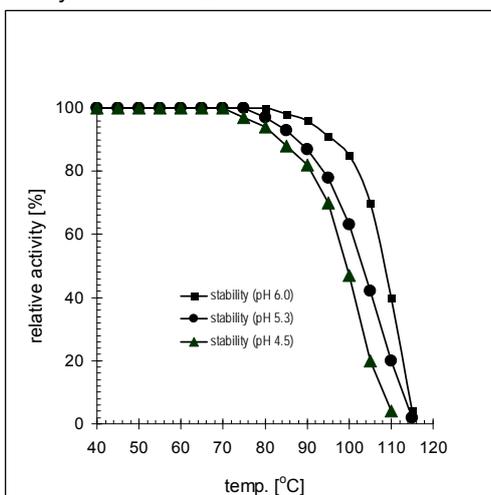


Fig 3: Influence of temperature on amylase-stability (10 % soluble starch, 1 h).

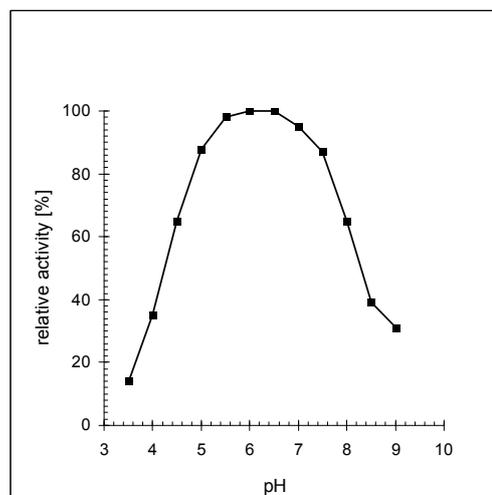


Fig 4: Influence of pH-value of the amylase-stability (10 % soluble starch, 90 °C, 1 h).