

Attenuation control and light beer production

Novozymes offers a broad range of attenuation control products to allow brewers to manage fluctuations in attenuation and create highly attenuated beers in a simple, cost-effective manner.

Benefits

- Customized solutions to reach specific attenuation targets and needs
- Manage consumer trends towards low-calorie and light beers
- Opportunity to reach desired maltose to glucose ratios
- Obtain the desired level of fermentable sugars every time

Products

Five products can be used—either alone or combined—to achieve desired attenuation levels within the specified production parameters of the individual brewery and brand:

Attenuzyme® Pro is a high-performing blend of glucoamylase and pullulanase that makes it possible to hit high attenuation targets in short reaction times, taking advantage of the synergy between these two enzyme activities during the hydrolysis of amylopectin and amylose.

Attenuzyme® Core is a glucoamylase for producing highly fermentable glucose-based worts.

AMG® 300 L BrewQ is a classic glucoamylase for producing highly fermentable glucose-based worts.

Attenuzyme® Clip is a pullulanase that accelerates attenuation and can be applied for a moderate increase in the attenuation of maltose-based wort.

Fungamyl® BrewQ is a maltogenic alpha-amylase used to breakdown of starches, facilitating a higher alcohol output.

Performance

The Novozymes range of attenuation enzymes help to break down amylose and amylopectin.

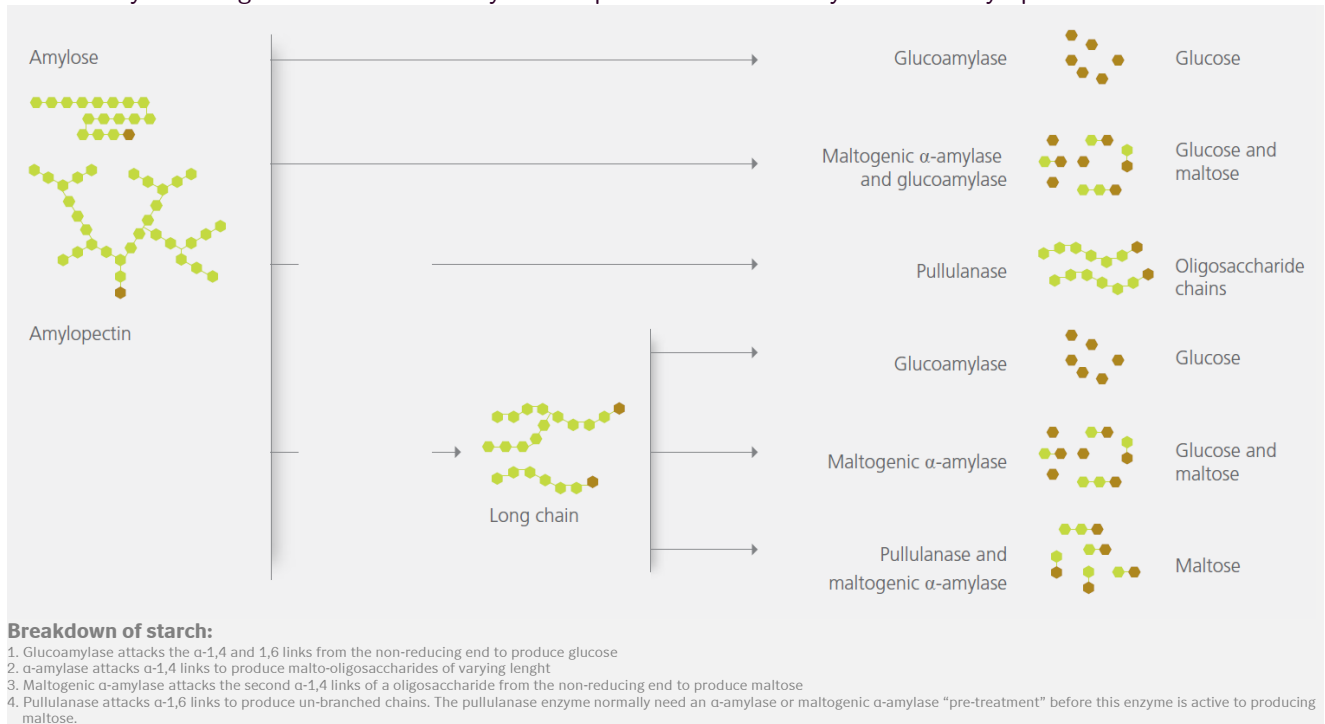


Fig. 1. Amylopectin breakdown to glucose and maltose by glucoamylase, α -amylase and pullulanase

The desired attenuation solution is a choice for the brewery to make. This application sheet focuses on the performance of Attenuzyme® Pro and Attenuzyme® Core, which are the recommended solutions for highly attenuated beer.

Rates of production of fermentable sugars are dose- and time-dependent.

Formed fermentable sugars [%] as function of the saccharification time

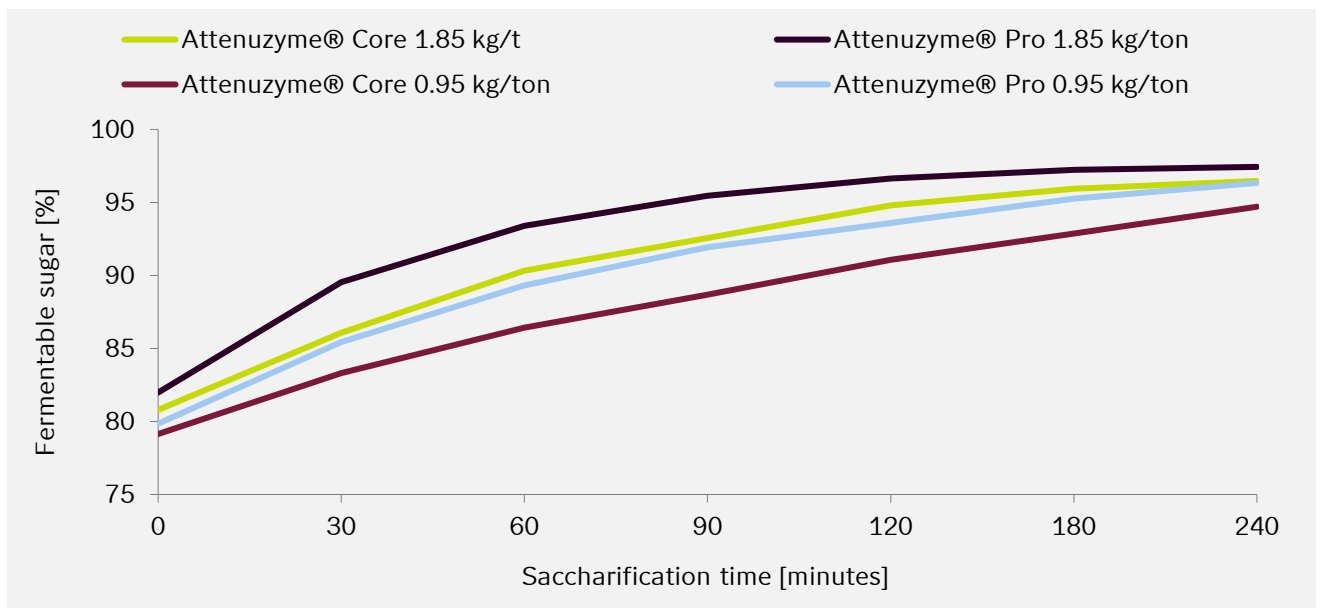


Fig. 2. Time response curves for Attenuzyme® Core and Attenuzyme® Pro on a 50% malt and 50% corn grist composition at 64°C, pH 5.4

As a rule of thumb, the RDF (real degree of fermentation) correlates with the amount of fermentable sugars * 0.91.

As shown in figure 2, Attenuzyme® Pro is faster at degrading dextrans into fermentable sugars when compared to Attenuzyme® Core due to additional pullulanase activity in Attenuzyme® Pro. The pullulanase works in synergy with malt β -amylase, generating a higher maltose content than Attenuzyme® Core and shortening saccharification times.

Usage

Dosage response curve for Attenuzyme® Core

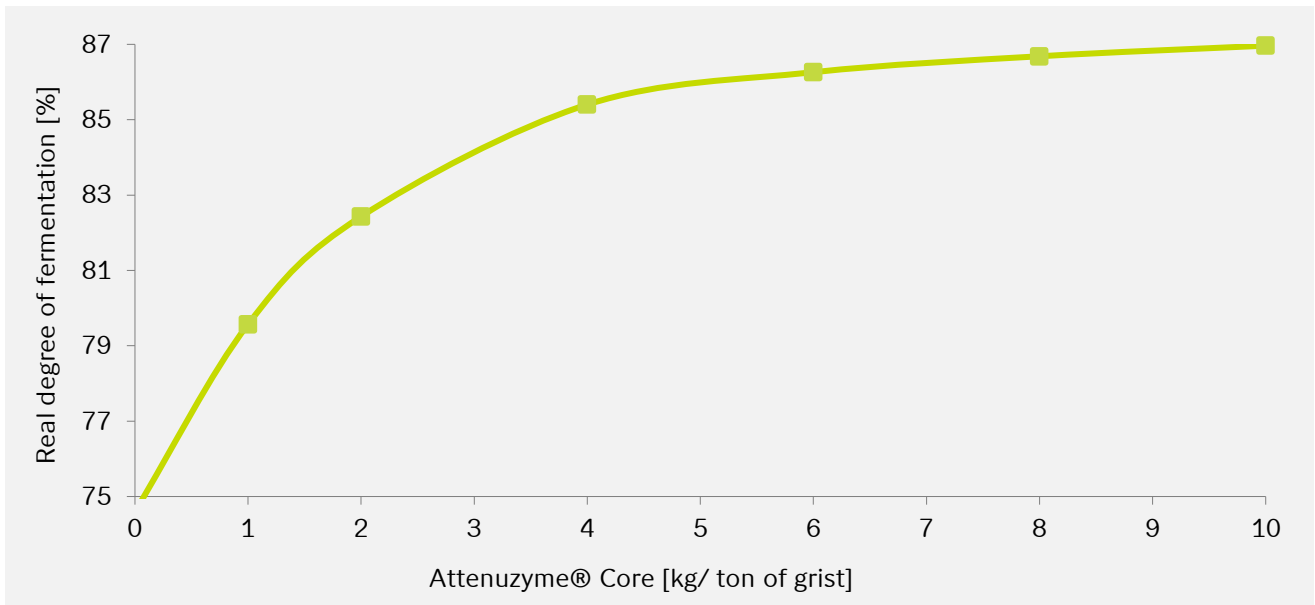


Fig. 3. Dosage response (real degree of fermentation [%]) of Attenuzyme® Core at 64°C after 60 minutes

Dosage response curve for Attenuzyme® Pro

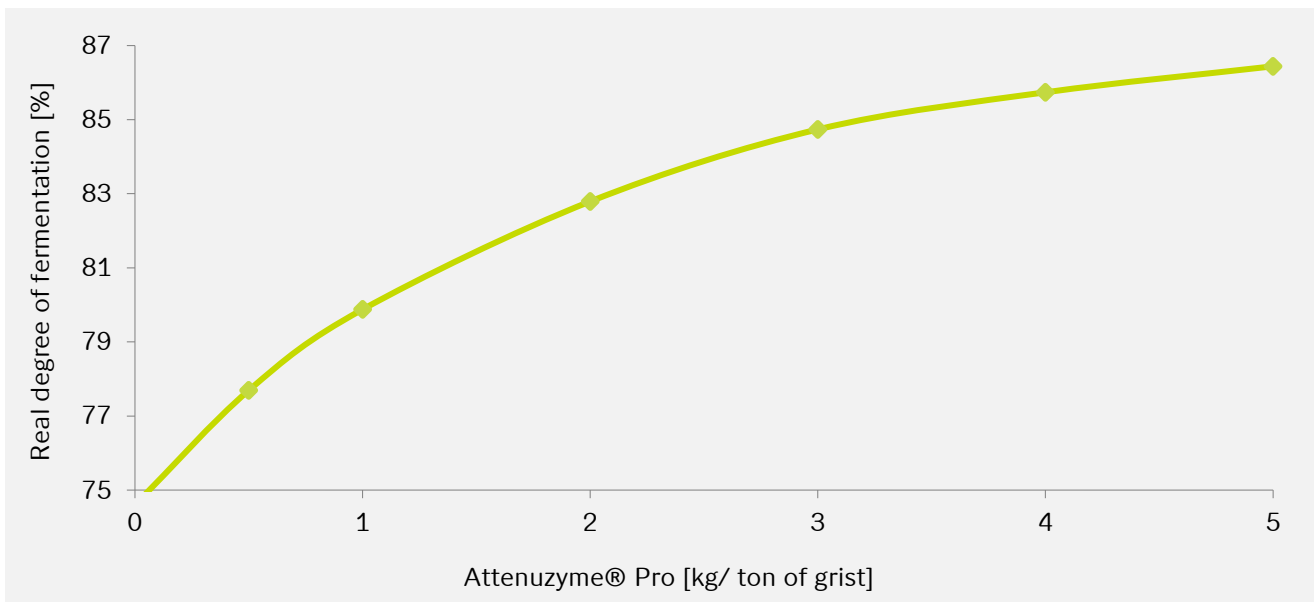


Fig. 4. Dosage response (real degree of fermentation [%]) of Attenuzyme® Pro at 64°C after 60 minutes

Application examples and dosage suggestions

Desired attenuation [%]	Option	Enzymes	Dosage range	Units (per ton grist or hL beer)	Point of addition	
RDF	ADF					
70–75	85–90	A	Fungamyl® BrewQ	0.5 to 5	g/hL	Start of fermentation
75–80	90–95	A	AMG® 300 L BrewQ	1.2 to 3.5	kg/ton	Mashing-in
			+ Attenuzyme® Clip	2.4 to 3.6	kg/ton	
		B	Attenuzyme® Core	0.35 to 1	kg/ton	Mashing-in
		C	Attenuzyme® Core	0.25 to 0.75	kg/ton	Mashing-in
			+ Attenuzyme® Clip	1.2 to 2.4	kg/ton	
D	Attenuzyme® Pro	0.3 to 1	kg/ton	Mashing-in		
80–90	95–100	A	Fungamyl® BrewQ	4 to 8	g/hL	Start of fermentation
			+ Attenuzyme® Clip	1.2 to 3.6	kg/ton	Mashing-in
		B	Fungamyl® BrewQ	2.4 to 4.8	g/hL	Start of fermentation
			+ Attenuzyme® Clip	12 to 18	kg/ton	
		C	AMG® 300 L BrewQ	6 to 18	kg/ton	Mashing-in or hot wort (63°C)
			+ Attenuzyme® Clip	6 to 18	kg/ton	
		D	Attenuzyme® Core	2 to 6	kg/ton	Mashing-in or hot wort (63°C)
		E	Attenuzyme® Core	1.5 to 5	kg/ton	Mashing-in or hot wort (63°C)
+ Attenuzyme® Clip	2.4 to 4.8		kg/ton			
F	Attenuzyme® Pro	0.25 to 5	kg/ton	Mashing-in or hot wort (63°C)		

Table 1. How to adjust fermentability

Attenuzyme® products are inactivated during wort boiling. In case of use during fermentation, normal pasteurization temperatures will not inactivate the enzymes, but this may cause post-sweetening of the beer.

Please contact our global Technical Service team for further suggestions on dosage during fermentation.

More information can be found in the “Brewing Handbook” and “Brewing Calculator,” both of which are available at Novozymes Market.

Optimum pH and temperature

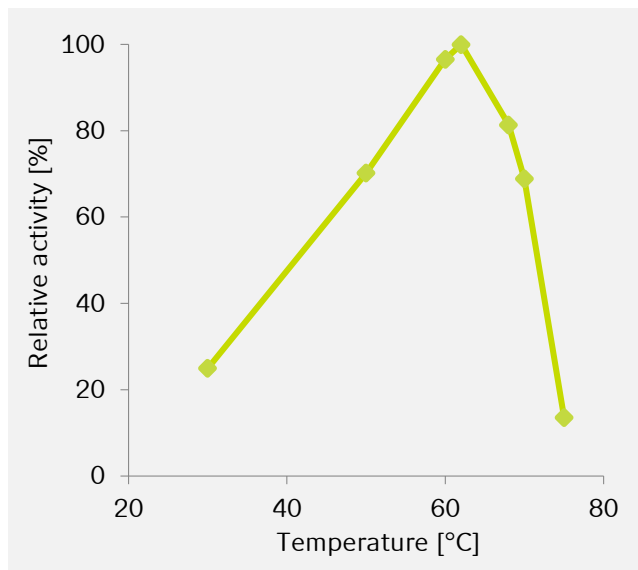


Fig. 5. Temperature activity profile of Attenuzyme®

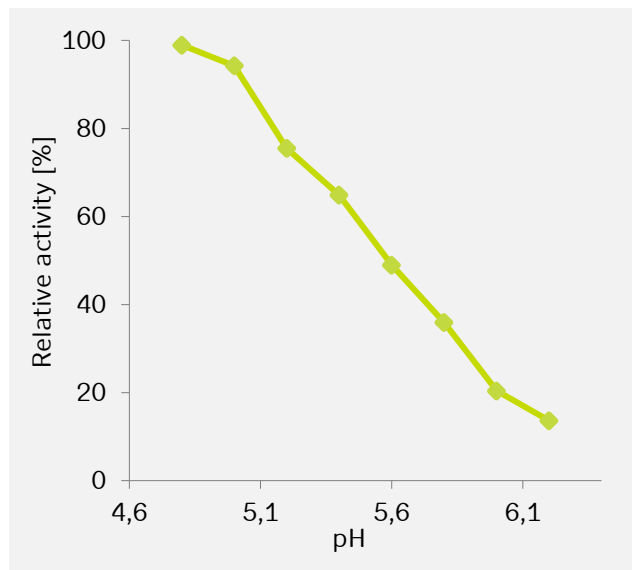


Fig. 6. pH activity profile of Attenuzyme®

Product data

Attenuzyme® Pro

Declared enzyme	A multi-component enzyme solution comprised of a fungal alpha-amylase, glucoamylase, and a patented pullulanase technology for accelerated production of highly fermentable glucose-based worts
Catalyzes the following reactions:	Glucoamylase that hydrolyzes (1,4)- and (1,6)-alpha-D-glucosidic linkages at the non-reducing ends of polysaccharides to produce glucose. Pullulanase that hydrolyzes (1,6)-alpha-D-glucosidic linkages in pullulan, amylopectin and glycogen to produce smaller fragments of linear dextrin
Declared activity	1300 AGU/g & 315 PUN/g
E.C./I.U.B.no.:	3.2.1.3 & 3.2.1.41
Physical form	Liquid
Production method	The enzyme product is manufactured via fermentation of a microorganism not present in the final product. The production organism is improved by means of modern biotechnology
Density	1.15 g/ml

Attenuzyme® Core

Declared enzyme	Glucoamylase (glucan 1,4-alpha-glucosidase)
Catalyzes the following reactions:	Hydrolyzes (1,4)- and (1,6)-alpha-D-glucosidic linkages at the non-reducing ends of polysaccharides to produce glucose
Declared activity	1600 AGU/g
E.C./I.U.B.no.:	3.2.1.3
Physical form	Liquid
Production method	The enzyme product is manufactured via fermentation of a microorganism not present in the final product. The production organism is improved by means of modern biotechnology
Density	1.13 g/ml

AMG® 300 L BrewQ

Description	A classic glucoamylase (amyloglucosidase), used for production of highly fermentable, glucose-based worts
Declared enzyme	Glucoamylase (glucan 1,4-alpha-glucosidase)
Catalyzes the following reactions:	Hydrolyzes (1,4)- and (1,6)-alpha-D-glucosidic linkages at the non-reducing ends of polysaccharides to produce glucose
Declared activity	300 AGU/ml
E.C./I.U.B.no.:	3.2.1.3
Physical form	Liquid
Production method	The enzyme product is manufactured via fermentation of a microorganism not present in the final product. The production organism is not modified using modern biotechnology
Density	1.17 g/ml

Attenuzyme® Clip

Description	A heat-stable pullulanase that accelerates production of highly fermentable worts when used in conjunction with a glucoamylase
Declared enzymes	Pullulanase
Catalyzes the following reactions:	Hydrolyzes (1,6)-alpha-D-glucosidic linkages in pullulan, partially degraded amylopectin and partially degraded glycogen to produce smaller fragments of linear dextrin
Declared activities	400 PUN/g
E.C./I.U.B.no.:	3.2.1.41
Physical form	Liquid
Production method	The enzyme product is manufactured via fermentation of a microorganism not present in the final product. The production organism is improved by means of modern biotechnology
Density	1.20 g/ml

Fungamyl® BrewQ

Description	A classic fungal alpha-amylase used to increase the breakdown of starches, facilitating higher alcohol output
Declared enzymes	Alpha-amylase
Catalyzes the following reactions:	Endo-amylase that hydrolyzes (1,4)-alpha-D-glucosidic linkages in starch polysaccharides
Declared activities	800 FAU-F/g
E.C./I.U.B.no.:	3.2.1.1
Physical form	Liquid
Production method	The enzyme product is manufactured via fermentation of a microorganism not present in the final product. The production organism is improved by means of modern biotechnology
Density	1.26 g/ml

More information about the products is available at [Novozymes Market](#).

Stability

Please see the Product Data Sheet at Novozymes Market.

Safety, handling and storage

Safety, handling and storage guidelines are provided with all products.

Get ahead

Staying ahead of the dynamic food and beverage market requires the best technology and expertise to become even more flexible, efficient and profitable. With our solutions and expertise, Novozymes can support you on that journey. Let's transform the quality and sustainability of your business together.

About Novozymes

Novozymes is the world leader in biological solutions. Together with customers, partners and the global community, we improve industrial performance while preserving the planet's resources and helping build better lives. As the world's largest provider of enzyme and microbial technologies, our bioinnovation enables higher agricultural yields, low-temperature washing, energy-efficient production, renewable fuel and many other benefits that we rely on today and in the future. We call it Rethink Tomorrow.

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