



BioTimes®



RONOZYME® PROACT

MAKES CHICKEN FEED MORE
DIGESTIBLE AND BROILER
FARMING MORE PROFITABLE

Novozymes is the world leader in bioinnovation. Together with customers across a broad array of industries we create tomorrow's industrial biosolutions, improving our customers' business and the use of our planet's resources.

Putting a green foot forward in	
the pursuit of sustainable washing	4
Alliance fights back as animal feed costs rise	6
Let's focus on food and nutrition	8
Giving farmers a jump start on their crops	10
650-horsepower moves biofuels in the right direction	12

Published by Novozymes A/S
Customer Communications
BioTimes® is distributed four times annually
(in March, June, September and December)
in English, Spanish, Portuguese, and Chinese.

Vol. XXIII, No. 4, 2008. Total circulation: 11,000

Address
Customer Communications, Novozymes A/S,
Krogshoejvej 36, 2880 Bagsvaerd, Denmark
Tel.: +45 4446 0000
Fax: +45 4446 9999

E-mail: biotimes@novozymes.com
Internet: www.biotimes.com

Editor
Susanne Strand

Assistant editor
Pamela Simms-Borre

Journalists
Jernett Karenson, Pamela Simms-Borre, and
Debbie Spillane

Copyright
Reproduction of articles from this magazine
is permitted with acknowledgement of source.
© Novozymes A/S. December 2008

Translation and proofreading
Borella projects

Design and graphic production
Datagraf Auning AS

Next issue
March 2009

Photos
DSM, EPIC, Getty images, Graae & Bangsbo, Morten
Jerichau, Shutterstock, Willi Hansen, and Novozymes

Paper
MultiArt Silk, a totally chlorine-free (TCF) paper.

Novozymes A/S accepts no responsibility for any errors
or omissions in *BioTimes* or any consequences of such.
Opinions expressed in this magazine are not necessarily
shared by the publishers.

Subscriptions: Free subscription is available for customers and business associates. Please register by sending an e-mail to biotimes@novozymes.com, stating the language version you wish to receive.

GENERAL



MAKING AN UNCOMMON CONNECTION

The Olympic Games and whale bone cleaning are two subjects that you might not immediately connect to Novozymes' solutions offering. But actually, our bio-innovations can be used in many very interesting ways. Sometimes you just have to make an uncommon connection.

You might have thought that the 2008 Olympic Games were all about the athletes. Of course they were, but they were also a stage for new products and technologies. Encouraged by the Olympic motto, "faster, higher, and stronger," companies across the globe showcased their capabilities before billions of spectators. Novozymes was both a host and a green solutions provider.

Clear, clean, and green Olympics

An algae invasion that hit the coast of China meant that a lot of time and effort was spent on cleaning up the coastal waters. The most sustainable way of eliminating the algae odor was to remove the source with bioenzymatic action. The technology was natural and safe for the athletes, spectators, and environment.

Beijing International Airport also needed a safe, natural solution to quickly and efficiently clean dirt and oil from its runways. Novozymes' bioenzymatic technology was the perfect alternative to harsh caustic or acidic cleaners, cleaning a wide range of materials, including concrete floors, fixtures, and tools.

A whale of a time

Degreasing whale bones is another interesting use of Novozymes' know-how and solutions.

It is such an exceptional idea that we have done it three times now.

The latest whale bone degreasing started this summer in cooperation with the Beaty Biodiversity Museum in Vancouver, British Columbia, Canada. Fifty tons of blue whale bones were placed in large, specially designed degreasing tanks. The bones were sprayed with a degreasing enzyme and immersed in tanks containing a bioenzymatic degreasing solution that removes the oil from the bones.

The bones remain in the solution for several weeks until they are cleaned. Then they will be assembled into a complete skeleton to be displayed in the museum's specially built glass atrium in late 2009.

Making the connection

Novozymes uses its substantial range of bio-innovations to question everyday conventions. We connect with the world around us in novel and unexpected ways to create the next generation of ideas, like whale bone degreasing, runway oil cleaning, algae odor clean-up, and other unconventional applications. To us it is more than a mindset. It is our way of doing business. For our customers and partners it is a pledge to meet the needs of the future, today. ■

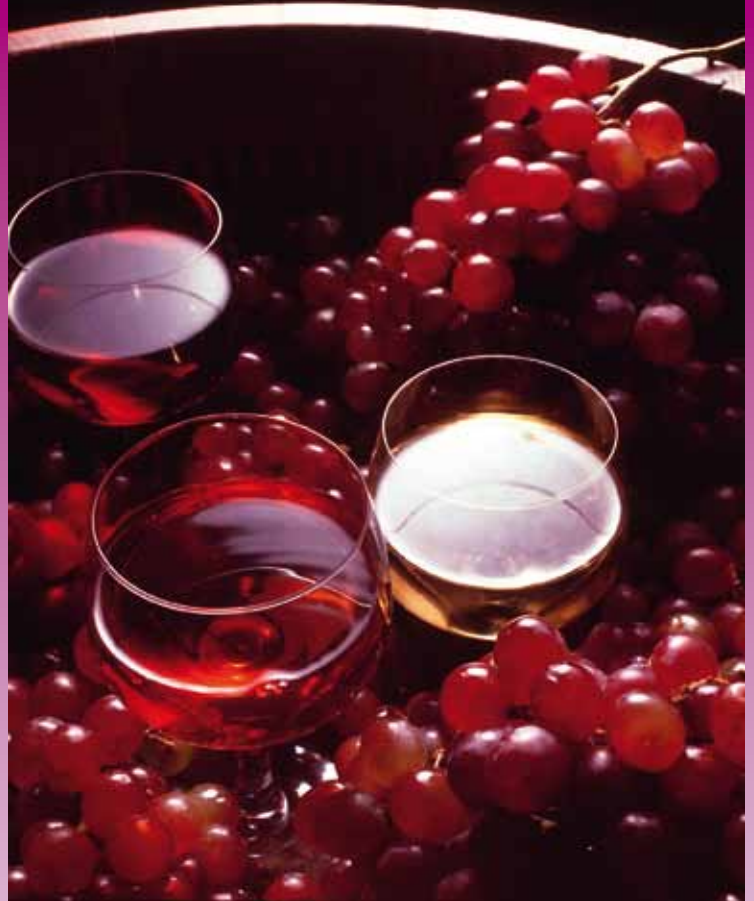


A HUGE BEAST
Blue whales are the largest animal ever to have lived on earth. The museum specimen has a 26 m long skeleton and a jaw bone that weighs approximately 1,500 kg.



Novozymes' latest wine industry offering is Vinozym Process, a unique, purified enzyme solution developed to complement modern extraction methods and improve the process efficiency in the production of red, white, and rosé short-maturation wines.

VINOZYM® PROCESS — WE MAKE THE WINE



Vinozym® Process primarily improves the extraction processes in the production of short-maturation wines.

Extraction enzymes are a popular choice for winemakers seeking to ease the extraction process through implementing enzymatic cell degradation. The enzyme activity on the grape skin ensures the release of must and a reduction in the viscosity, or glutinous consistency, of the mash. Vinozym Process optimizes the traditional benefits offered by extraction enzymes, with the added flexibility needed to supplement the mechanical extraction techniques associated with short-maturation wines.

"Our new enzyme will generate superior performance in classical as well as in thermo extraction processes," says Guillaume Trepo, Wine Marketing Specialist at Novozymes.

Enhance extraction and cut costs

Vinozym Process enables a potential increase in must yield of 5–10% and a reduction in the volume of gross lees by up to 50%, ultimately resulting in increased profitability for the winemaker. Productivity gains are also generated through reduced production time and optimized capacity of the existing extraction equipment.

"One satisfied Novozymes customer using Vinozym Process on white grapes enjoyed an increase in must yield of 7% while reducing the press cycle from 230 to 170 minutes," says Rémi Lévêque, Account Manager at Novozymes. This success story translates to an impressive economic benefit of at least EUR 5,600 for each batch of 1,000 hl treated.

Vinozym Process is an innovative answer for

wine manufacturers seeking to increase yield, clarification, and quality while maximizing the capacity of their extraction equipment. The value and efficiency of Vinozym Process makes it an excellent economical solution for short-maturation wine production.

"Vinozym Process primarily aims at improving the extraction processes in terms of speed, performance, and cost," says Frédéric Issenhuth, Global Marketing Manager, Wine and Juice at Novozymes. "This helps winemakers reduce gross lees – or remains – and increase juice yield, while increasing color intensity and tannins."

The quality of the resulting wine is improved, displaying an increase of up to 10% color intensity, up to 50% more tannins after alcoholic fermentation, and intensified aroma and body.

"The secondary key benefit is the reduction of turbidity by up to 90% after extraction," Frédéric Issenhuth continues. "This helps a winemaker save essential time and costs during the clarification process." This level of success is also achieved in wines that are traditionally difficult to produce, such as high-pectin white musts from Semillon, and in thermo-treated red musts.

The science behind the sensation

Vinozym Process starts working at the very beginning of the wine process. Selected pectinases within Vinozym Process hydrolyze the cell wall polysaccharides and ensure the release of must, resulting in easier processing and a higher yield.

"Vinozym Process proves its efficiency by increasing the overall must yield," says Rose-Marie Canal-Llaubères, Customer Solutions Manager at Novozymes. "Thanks to selective enzyme activities, the grape must is easily extracted through the press, and the volume of low-pressing fractions increases."

After pressing, the grape must is usually turbid and shows a certain viscosity due to the presence of pectins. Pectinases from Vinozym Process act on the pectin matrix and colloidal structure of difficult musts to reduce the must viscosity and enable faster and easier settling of the must. Good clarification is essential for winemakers to quickly achieve a sufficiently low turbidity before alcoholic fermentation. The increase in the speed of the settling process also reduces the risk of the development of spontaneous fermentations of endogenous microflora, and protects the qualitative elements of the must such as flavor, body, and aroma.

"Vinozym Process has helped to reduce the pressing time by 30% in white and rosé production. This is a major benefit for large wineries having to deal with large volumes of grapes every day and who have to reach good clarification prior to fermentation within a very short period of time," says Rose-Marie Canal-Llaubères. "Thanks to the good clarification effect, the must is easier to depectinize and filter and this enables smooth downstream processing such as the use of rotary vacuum filters."

- Specific pectinase activities contained in Vinoxym Process ensure the efficient release of valuable tannins, anthocyanins, and aroma precursors from the skin, increasing the quality of the resulting wine. "Vinoxym Process is helping both the process and the quality of the wine," says Rose-Marie Canal-Llaubères. "It's important for each winery to monitor the benefits – the increase in must yield and clarified juice volume generates rewarding economic gains."

Sustainability for the future

Not only does this extraction enzyme offer exceptional benefits while improving profits and cutting costs, it is also eco-friendly. In times of environmental concern, future sustainability is a hot topic. As Vinoxym Process enables wineries to maximize the efficiency of extraction equipment and techniques, it results in a reduction in energy consumption. The increase in yield experienced means that more wine is produced from the same quantity of grapes, indicating that these fruits can be used more effectively as a raw material in wine processing.

Experiencing excellence

Throughout 2007, Vinoxym Process was successfully tested by many wineries, with over 15,000 tons of grapes treated for the production of short-maturation wines, and they were pleased and excited by the results they experienced. In 2008, based on sales in the northern hemisphere, Vinoxym Process is forecasted to become Novozymes' second biggest granulated enzyme for the extraction step.

Working with the wine

This Novozymes bioinnovation effectively enhances the extraction process through increasing must yield and improving the effectiveness and capacity of the existing production equipment. The value of the final product also grows due to improvements in color, tannins, and flavor. Considering how effective and economical Vinoxym Process is, the choice to implement such an easy and innovative solution when producing short-maturation wines should be a simple one. ■

EXPERIENCE VINOZYM® PROCESS

If you are a winemaker and want to experience excellence, contact wineprocessing@novozymes.com to request a sample of Vinoxym Process.

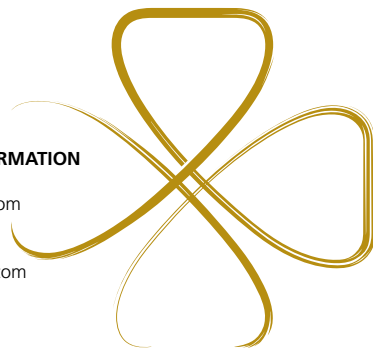
LEARN MORE

Visit the wine industry under Products & Solutions at Novozymes.com, and watch the new video to learn more about enzymes in winemaking.

FOR MORE INFORMATION

Frédéric Issenhuth
frei@novozymes.com

Guillaume Trepo
guit@novozymes.com



PUTTING A GREEN FOOT FORWARD IN THE PURSUIT OF SUSTAINABLE WASHING

The detergent industry is feeling the pain of increasing raw material prices as it tries to cope with the demand for high-performing and greener, more sustainable products at the same cost. Novozymes is leveraging its experience with bioinnovation to offer enzymatic solutions that not only help stabilize formulation costs but also add to the overall sustainability of detergents.

Today, the biggest chunk of detergent formulation cost is dedicated to surfactants and builders. These ingredients have over the past few years experienced some of the largest price increases among detergent raw materials. At the same time, enzymes have enjoyed a relatively stable cost development.

"The time has come for detergent manufacturers to decouple their cost base from ingredients that are affected by volatile energy prices and resource shortages, and ensure they offer their customers a superior and environmentally friendly product at an acceptable cost," says Anders Lund, Marketing Director for detergents at Novozymes.

Working toward a greener detergent

Detergent manufacturers around the world are seeking innovation that can make their products more sustainable.

One clear path to creating a more sustainable detergent is to use more sustainable feedstock, use compaction wherever possible, utilize low-volume materials like polymers, and increase the use of biobased ingredients like enzymes to replace surfactants, according to Charles Bragg of Procter & Gamble, who spoke about sustainable detergents at the 7th World Surfactants Congress in June 2008 in Paris*.

"At Novozymes, for years now, we have been figuring out how enzymes work with other ingredients in a formulation; and now we're using our knowledge to replace detergent ingredients with a multi-enzyme solution," says Sandra Friis-Jensen, Global Launch Manager for detergents at Novozymes. "We have extensive research in-house and from collaborations with partners that clearly show that a customized multi-enzyme solution can replace a percentage of surfactants and builders, or a percentage of the overall formulation – without loss in wash performance."

Detergent manufacturers are also looking for biobased alternatives to chemicals that are already banned, or risk being banned, in several countries.

One example of this is phosphate-based builders such as STP/STPP, which are banned in several countries because phosphorus



Part of the team working on optimizing detergent formulations with a multi-enzyme solution.

More and more consumers are getting on the sustainability bandwagon, looking for environmentally friendly labels on the products they purchase in the supermarket while not wanting to dip into their pocket books any deeper than they already are. However, the high price of oil and the pressure on natural resources are increasing the price of raw materials and thus the cost of end-consumer products.

causes eutrophication (depletion of oxygen in water bodies) of many fresh waters.

Dr Ulrich Pegelow from Henkel spoke at the Cleaning Products conference in September 2008 in London about the efforts made by Henkel to replace STP/STPP with solutions that have a better ecological profile.

Research conducted by Novozymes shows that a multi-enzyme solution optimized for a particular formulation can substitute STP/STPP and still maintain detergent performance. Since enzymes are readily biodegradable, they offer an environmentally friendly answer to phosphate-based ingredients.

"Sustainability has been the major theme in several recent detergent conferences in Europe and the United States. And all the stakeholders are very clear about sustainability being the way forward for our industry," says Michael Carlsson Lauesgaard, Marketing Manager for Europe at Novozymes. "Reformulating with enzymes is the low-hanging fruit that helps formulators improve detergent sustainability and performance without compromising costs."

Lower the temperature

One of the benefits of using detergent enzymes is that they are also efficient at low temperatures. This is important when looking at the life cycle of a laundry detergent. According to Charles Bragg, in Western Europe 75% of the energy consumed during the life of a laundry detergent is consumed during the in-use phase and is used specifically to heat water for washing*.

"It's now possible to use a detergent reformulated with enzymes and get the same result at temperatures of 30 °C or 40 °C for wash that before only showed good results at 60 °C," says Hanne Philbert Nielsen, R&D Science Manager at Novozymes. "Danlind's CARE product is a good example of how reformulation can ensure high performance at low temperatures. Danlind optimized their formula with four types of enzymes,

an altered surfactant system, and a bleach activator to achieve a high-performance cold-wash detergent."

Sustainability is the talk of the town

Besides making their products more environmentally friendly, detergent manufacturers are increasing the sustainability profile of their corporations by investing in carbon footprint reduction.

Large detergent producers like Procter & Gamble, Henkel, Unilever, and Reckitt Benckiser have all launched efforts to create environmentally friendly cleaning products. Reckitt Benckiser is taking this one step further, announcing its aim to reduce the company's carbon footprint by 20% by 2020; and P&G has announced that the company will reduce CO₂ emissions, energy and water consumption, and disposed waste by 40% by 2012.

Novozymes is underscoring its position as a leader in sustainability by entering a partnership with DONG Energy, a Danish energy company, to make site Novozymes Denmark carbon neutral for electricity as early as 2012.

"As a socially and environmentally responsible company, we constantly try to optimize the energy efficiency of our production. Now we are taking the next step to base our production on renewable energy," says Anders Lund. ■

FOR MORE INFORMATION

Sandra Friis-Jensen
sfj@novozymes.com

* Source: Tom Branna, Troubling Times, *Happi*, August 2008.

WHAT ARE SURFACTANTS AND BUILDERS?

Surfactants and builders are traditional detergent ingredients. Surfactants are surface-active agents that help remove soil from fabric surfaces and keep the soil in suspension in the wash solution so that it does not redeposit on clothes. Builders function as service chemicals for the remaining detergent ingredients and constitute the chemical and physical backbone in a detergent. For example, builders reduce water hardness and therefore increase the efficiency of some surfactants.



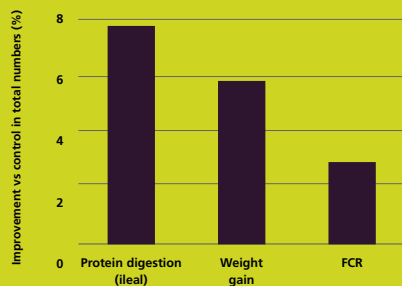
Alliance fights back as

Take two companies, 10 years of hard work, and a project that involved more than 100 employees and you get RONOZYME® ProAct – a game-changing enzymatic solution that makes chicken feed more digestible and broiler farming more profitable.



RONOZYME® ProAct unlocks the nutritional value of a large variety of proteins by complementing the activity of digestive enzymes, such as pepsin and pancreatic proteases, thereby releasing more peptides and free amino acids for uptake.

FIG. 1. BETTER WEIGHT GAIN, BETTER FEED CONVERSION



Trials show that RONOZYME® ProAct improves protein and energy digestibility significantly when added to diets containing low crude protein and correspondingly reduces essential amino acid levels. These results translate into significant improvements in weight gain and feed conversion ratio.

animal feed costs rise



"It all started when DSM identified a market segment in the animal feed industry that had great potential," remembers Lene Nonboe Andersen, Senior Science Manager and RONOZYME ProAct project leader at Novozymes. "They wanted to know if we could work together to find an enzymatic solution to improve digestion of vegetable proteins, particularly soy, in animal diets."

That was the spark which led to a project that would span a decade, ride out numerous highs and lows, and eventually help support an alliance that creates animal nutrition products unmatched by other companies in the industry today.

Looking back

"Prior to this project the animal feed industry had only disappointing experiences with proteases," says Joachim Pfeiffer, Director R&D Program Animal Nutrition & Health at DSM. "But with encouragement from our R&D counterparts at Novozymes, we decided that it was worth the effort to take a closer look at finding a protease that could work in animal feed applications."

In 1999 Novozymes began the big task of screening proteases to see if any of them might have a positive effect on the hydrolysis of vegetable proteins like soy.

"We soon discovered a unique protease that had great potential," says Lene Nonboe Andersen. "Following the discovery it took us years of hard work and close collaboration with DSM to develop the application and optimize production."

To make a decade-long story short, DSM and Novozymes pooled their significant expertise – Novozymes in enzyme screening, strain development, formulation, and production, DSM in animal nutrition, feed technology, and sales & marketing – to work on this new protease.

"There were a couple of times when the project almost died," says Joachim Pfeiffer. "There were times with bad luck, times with inconclusive results, and also times where we were a little bit too enthusiastic. But looking back

now, we really have to pay tribute to the people on both sides. Despite significant setbacks we always managed to get back on track. It was a great learning case for all of us involved."

And through this long process of trial and error, not only did an exceptional product finally emerge, but the alliance was revitalized as well. Since 2001 the two companies have been joined in a successful global alliance focused on improving and expanding their mutual product offerings.

"Working together with DSM on the development of RONOZYME ProAct is an amazing realization of our alliance," says Peter Christensen, Alliance Manager at Novozymes. "Novozymes and DSM colleagues from all functions, particularly R&D and Regulatory Affairs, and all over the world have been part of this development and together we have created a truly innovative solution that is sought after in the market. That is exactly what we envisioned with this alliance."

Reducing the costs

Farmers are under tremendous pressure these days. Higher feeding costs are reducing their profits and placing stress on the entire industry, but fortunately this new breakthrough feed solution gives farmers a way to actively combat these rising costs.

Trials have shown that RONOZYME ProAct enables broiler chickens to optimize their performance potential. RONOZYME ProAct improves protein digestibility when added to diets containing low crude protein and correspondingly reduces essential amino acid levels. This translates into significant improvements in weight gain and feed conversion ratio. Figure 1 shows that, by using RONOZYME ProAct, broilers gain a substantially higher final weight and improved feed conversion ratio (i.e., ratio between feed intake and weight gain).

The benefits for the animals have been described above, but the benefits for the farmers are just as impressive. Even with the additional cost of the supplemented enzymes in the feed,

using RONOZYME ProAct lowers total feed costs by several percent. This means farmers can potentially save a lot of money, particularly in light of the sharp rise in feed costs during the past couple of years.

Digestion-boosting enzyme

RONOZYME ProAct is a protease that catalyzes the hydrolysis of dietary proteins into peptides and amino acids, making these nutrients more readily available for uptake and further utilization by the broilers. It is an unspecific protease, which means that it increases the solubilization and degradation of a wide range of feed proteins, making diet formulation more flexible. It complements the animals' own digestive enzymes, such as pepsin and pancreatic proteases, which are found in the digestive tract.

RONOZYME ProAct is the newest in a wide range of specifically designed feed enzyme solutions in the joint DSM & Novozymes portfolio and it is fully compatible with Phytase and other feed enzymes commonly used.

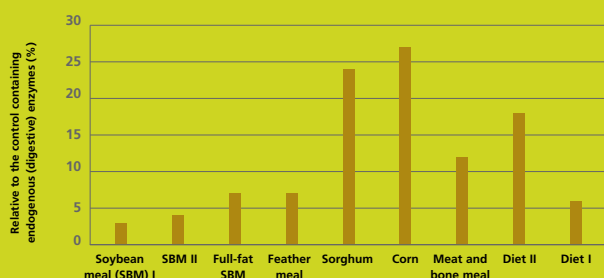
Truly needed in the market

In recent years global trends have been converging to make alternative nutritional solutions for animal feed increasingly profitable.

Significant increases in feed and food prices, particularly grain prices, due to a fast-growing population, unsatisfactory harvests, and increased competition for raw materials, have hit the animal farming industry hard. In addition, the demand for meat across the globe is rising at an estimated 2–3% due to increasing populations and urbanization.

Not only have these trends raised the price of the raw materials used for animal feed, but the available raw materials are often of lower quality which, without nutritional boosting, potentially impacts the animals' health and growth negatively. Fortunately RONOZYME ProAct gives broiler farmers a low-cost, high-gain solution that works against these market trends. ■

FIG. 2. COMPLEMENTS DIGESTIVE ENZYMES



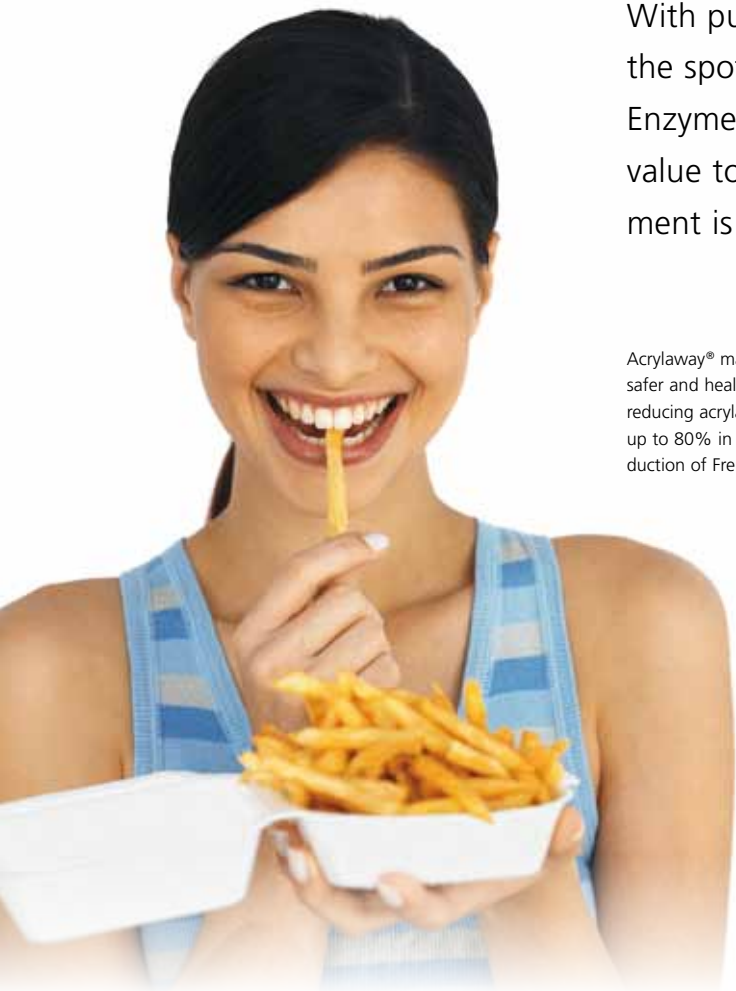
Trials using a gastrointestinal model including digestive enzymes (pepsin/pancreatic proteases) demonstrate improved protein digestibility when RONOZYME® ProAct is added to different protein raw materials and to typical broiler diets.

FOR MORE INFORMATION

Lene Nonboe Andersen
lna@novozymes.com

Peter Christensen
ptch@novozymes.com

LET'S FOCUS ON FOOD AND



With public awareness of the importance of health and diet rising, the spotlight is on the content of food and its preparation processes. Enzymes can help replace undesirable ingredients and add nutritional value to food products, and Novozymes' Food & Nutrition department is the engine driving innovation in this exciting market sector.

Acrylaway® makes food safer and healthier, reducing acrylamide by up to 80% in the production of French fries.



"Whether our customers want to ensure safe and healthy food through reducing acrylamide, offer convenient, protein-fortified dietary supplements, or get more yield from mozzarella, Novozymes has an original and effective solution that combines profitability with meeting consumers' preferences," says Flemming Mark Christensen, Global Marketing Manager, Food & Nutrition at Novozymes.

WINNING AWARDS AND LOYAL CUSTOMERS

Acrylaway®, Novozymes' highly acclaimed asparaginase, has been stealing headlines for its effective reduction of acrylamide in dough-based products without changing the taste and appearance of the final product. Having been applied initially with commercial success across a broad range of foods such as biscuits, crackers, crispbreads, and snacks, acrylamide reductions of up to 80% have been proven possible in the production of French fries, with additional substantial reductions in acrylamide levels in the field of potato-based snacks.

"We see an increasing interest from the industry for reducing acrylamide in potato-based products," says Emmanuel Michelot, Regional Marketing Manager in Novozymes' Food & Nutrition department. "Testing or implementation is ongoing at several customer sites producing dehydrated potato snack ingredients, and we are currently enjoying our first sales to a European potato-based snack producer."

On July 8, Novozymes was recognized at the 2008 Ringier Technology Innovation Awards for Food & Beverage Industries in China. Winning the prestigious Food and Beverage Ingredient Technology category for Acrylaway, it seems global success for this asparaginase is just beginning.

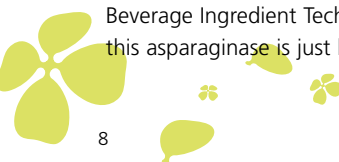


CREATIVE COLLABORATION

The dairy industry was energized by 2002's ground-breaking alliance between Novozymes and natural ingredient producer Chr. Hansen. Managed from within the Food & Nutrition department, this unique relationship, combining Chr. Hansen's highly specialized dairy market knowledge and Novozymes' bioinnovative know-how, brought about YieldMAX® in 2005, an original solution that increases yield in the production of stretched-curd cheese such as mozzarella and provolone.

YieldMAX is added to milk as a pretreatment process to optimize coagulation, ultimately resulting in an increase in yield of up to 2%. Although this may not seem a significant amount to the noncheesemaker, it is estimated that the combined efforts of the entire dairy industry over the past decade increased cheese yield by just 1%. While dairy enzymes currently account for the largest segment of Europe's EUR 200 billion food enzyme market, it remains an area of unfulfilled potential, and one of unlimited opportunity for this dream team.

"With our current alliance portfolio and a very strong project pipeline, we are in a strong position for growth throughout the coming years," says Nis Peter Christensen, Strategic Account Manager at Novozymes. "This will cement the position of the alliance as 'the leading provider of enzyme-based innovations to the dairy industry'."



NUTRITION



▶▶ GET HEALTHY ON THE GO

Hectic lifestyles, health and diet awareness, and a growing aged population have encouraged an increase in the need for nutritious and convenient snacks. Protein-rich drinks are a popular product for this highly receptive market, and their production depends heavily on vegetable and dairy proteins as key ingredients. Use of pioneering proteases can greatly improve the production of these products by improving digestibility and providing readily absorbable and soluble proteins or peptides. The protease selection for treatment is critical as it ensures that the hydrolysates are not only soluble but also free from the bitter taste often associated with peptides.

Novozymes' offers unique bioinnovation products: Alcalase® 2.4 L, Protamex®, Neutrase® 0.8 L, and Flavourzyme® 1000 L, which improve the heat stability of the peptides present in the hydrolysates, while also reducing the bitterness. Not only do the resulting products taste better and are more heat stable, but the higher amounts of soluble and heat-stable proteins and peptides produced result in a higher yield. So consumers enjoy a convenient, great tasting, easily absorbable protein drink, and manufacturers enjoy excellent process economy and loyal consumers.



GAG EXTRACTION GETS GREENER

As reported in the last edition of *BioTimes*, the use of enzymes is changing the production of soy sauce by increasing yield, intensifying flavor, reducing fermentation, and producing a healthier product through the elimination of 3-MCPD (3-monochloropropane-1,2-diol). But this is not the only Food & Nutrition success story in Asia. The production of GAGs in China is turning to enzymes to establish a cleaner source product while getting sustainable.

GAGs, or glycosaminoglycans, are widely found in animal tissue, including lungs, intestinal mucosa, trachea, and rooster combs and skin, from which they can be extracted. Chondroitin sulfate and glucosamine are two GAGs that are key components in joint-targeted treatments, essential in keeping the growing elderly population mobile. Their complicated extraction involves the breakdown of the surrounding tissues and core proteins to which the GAGs are covalently linked. The process begins when the raw materials are cleaned by proteases to secure a meat protein-free and cleaner base from which to begin the GAG extraction process.

Although significantly cleaner GAGs is the primary benefit from using enzymes during the extraction process, manufacturers also relish in increased production yield and additional peace of mind in knowing the environmental advantages this method brings. Using enzymes during alkaline hydrolysis reduces some of the environmental drawbacks associated with this method, and in eco-friendly times as these, such benefits cannot be underestimated. Enzyme use in GAG production reduces both the solid waste produced and the amount of water required for downstream processing.



Innovation and experimentation

With exciting pipeline products and unique customer-focused projects, Novozymes' Food & Nutrition department truly encapsulates the energy and creativity that is bioinnovation. ■



FOR MORE INFORMATION
Flemming Mark Christensen
fmc@novozymes.com

Emmanuel Michelot
emi@novozymes.com

Petra Mehrrens-Rothe
prot@novozymes.com

GIVING FARMERS A JUMP

Strong commodity prices for corn, canola, and other crops, as well as the rising cost of fertilizer, have motivated farmers to maximize their crop yield and the efficiency of their fertilizer investment. Novozymes' JumpStart®, a phosphate inoculant, lets them do both and do them in an environmentally friendly way.

Phosphate is an essential nutrient for plant growth and as such is important to maximize a field's yield potential. Often phosphate is present in large amounts in the soil, but in a form that is unavailable to the plant.

"Even when phosphate fertilizer is applied at the time of planting, it can quickly bind with calcium, magnesium, and iron minerals in the soil, resulting in the phosphate being inaccessible to the crop," says Garry Hnatowich, Senior Agronomist at Novozymes Biologicals – BioAg in Canada. "That is where JumpStart comes in."

JumpStart is a fertility management tool that is applied as a seed treatment to the seed prior to planting or with the seed at planting. The active component in JumpStart is a naturally occurring soil fungus – *Penicillium bilaii*.

As the seeds germinate and develop a root system the JumpStart fungus and the plant form a mutually beneficial relationship. The fungus grows and multiplies along the crop roots, thriving off the root exudates and releasing organic acids into the soil. These acids break the bonds holding the phosphate nutrient in a mineral

form, releasing the phosphate into a form the plant can access. The result is enhanced phosphate uptake allowing the crop to achieve its yield potential.

Meeting many needs of the farmer

JumpStart promotes greater phosphate use efficiency, which results in quick emergence, early vigor, greater stress tolerance, and more even maturity.

"It delivers a safe method of supplying phosphate to growing plants and in some instances reduces the need to seed-place high rates of fertilizer phosphate, which can have a negative effect on sensitive crops," says Garry Hnatowich.

Cool soils, common during direct or early seeding, can reduce phosphate availability due to the limited mobility or movement of phosphate in the soil. Poor early season phosphate availability can reduce early growth. JumpStart is active in cool soils as low as 4 °C (40 °F) and supplies an immediately available source of phosphate to developing seedlings, resulting in quicker emergence and early vigor.



Plants with larger root systems have the ability to better withstand a variety of stresses like drought and seedling diseases. JumpStart promotes root growth, making the plant better able to access moisture and a range of needed nutrients, not just phosphate, so the plant is better able to withstand a variety of crop stresses.

JumpStart promotes even crop maturity as well. It increases the amount of phosphate available to the crop throughout the growing season. The amount of phosphate available in a typical field can vary from 2 to 4 times the average within very short distances. Using JumpStart helps ensure every plant gets better access to phosphate. This results in increased uniformity of crop emergence, development, and maturity. Earlier, more uniform maturity often means earlier harvests and higher quality grain.

Farmers can see the difference

Farmers see the benefits of using JumpStart and many recommend it to their neighbors.

Rick Brown, a canola farmer from Indian Head, Saskatchewan, Canada, says: "The canola that is



START ON THEIR CROPS

Inoculants are microbial-based crop input products that help plants access nutrients. JumpStart® is a phosphate inoculant containing the naturally occurring soil fungus *Penicillium bilaii*.



THE BENEFITS OF JUMPSTART®

Improved crop performance

- Root development
- Stress tolerance
- Seed quality
- Earlier, more uniform maturity
- Better fertilizer use
- Higher yield

Lower phosphate fertilizer requirements

- Handling, transportation, storage, and time savings
- Lower environmental impacts

treated with JumpStart comes out of the ground quicker and stronger than the crops not treated. JumpStart allows the canola to access the soil phosphate faster under cool conditions. I would recommend JumpStart to my neighbors. I think it's well worth the time, effort, and money."

Patrick Fabian, a seed grower from Tilly, Alberta, Canada, has this to say about JumpStart: "Over the course of three years we tried it on wheat, canola, and even on alfalfa. We realized that there was a significant [yield] difference on the alfalfa and at least a 6–8% difference in yield on the wheat and canola. So now, it has just become a standard process on our farm that we apply JumpStart when we're seeding."

And the benefits are not only common to canola farmers. Corn farmers in the US are also extremely positive about the results they see.

"With JumpStart you're putting more money in your pocket because you're helping your crop use its full yield potential," says Joel

Lampert, of Dakota Crop Services in Kensal, North Dakota. He continues, "We're seeing better emergence, a better stand, and also a better root system; so the plant can withstand stresses during the growing season like cold ground or drought. Actually, in the last three years we've seen an average of 5.2 bushels per acre yield increase using JumpStart."

Expanding a mature technology

The JumpStart technology was first commercialized in Canada in 1991. It is currently marketed in the agriculture sector in Canada and the US with launches pending in Australia and Argentina. In addition, a Novozymes R&D project, which is nearing completion, forecast a "next generation" of JumpStart that will take performance to higher levels.

With its microbial-based solutions, Novozymes is helping the world's farmers produce more and better food, feed, fuel, and fiber, while minimiz-

ing the environmental footprint of production agriculture.

"JumpStart is just one of several microbial-based products that can help farmers produce the crops that we use to eat, drink, drive, and otherwise consume, more efficiently," says Ken Bartsch, Communications Manager, Novozymes Biologicals – BioAg.

Reducing the environmental footprint of agriculture

The many positive impacts of JumpStart on crop production and yield are causing many farmers to incorporate the product into their crop fertility plans. However, a preliminary Life Cycle Assessment (LCA) has shown that JumpStart also has many potential positive environmental impacts, which will be further explored in the future. ■

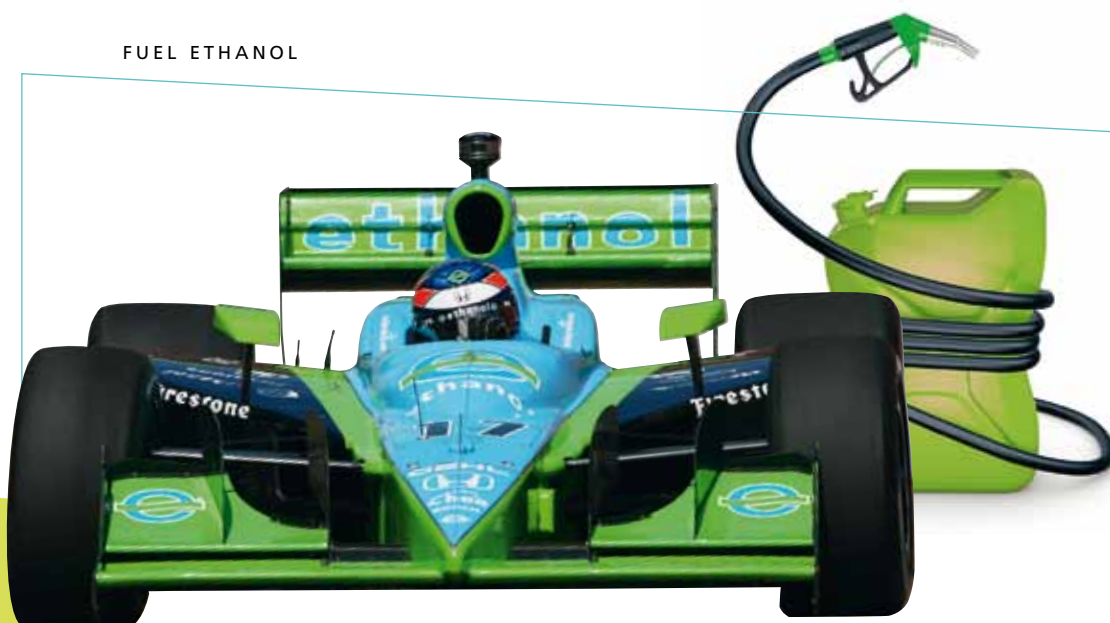
FOR MORE INFORMATION
Ken Bartsch
kbrs@novozymes.com





novozymes®

Rethink Tomorrow



650-HORSEPOWER MOVES BIOFUELS IN THE RIGHT DIRECTION

The IndyCar® Series was the first motorsports league to begin using renewable fuel in its vehicles. And in 2007, the series started its first race with cars powered by 100% fuel-grade ethanol.

The IndyCar Series began its move to renewable fuels in 2006, switching from methanol-based fuels to an ethanol blend. The changeover to 100% ethanol took place in March 2007. With this bold move, the IndyCar Series became the undisputed motorsports leader in renewable and environmentally responsible fuel. This valuable endorsement proves that ethanol is a fast and safe fuel solution, even at the highest levels of auto racing.

High performance for all

All IndyCar Series cars use the same fuel to eliminate any competitive advantage a team might gain by using a specialized fuel. LifeLine Foods, a pioneer in both food and energy, is the official supplier of the 100% ethanol used in the IndyCar Series. Novozymes provides LifeLine with the enzymes it uses for ethanol production.

From a performance standpoint, the transition to ethanol from methanol-based fuel has been a huge success. Without any loss of horsepower or speed, the cars now burn 20,000 fewer gallons of fuel. And due to increased fuel mileage after the switch, the cars showcase a 22-gallon fuel tank. Prior to the move the tanks held 30 gallons.

The pure ethanol used in the series today has a higher octane rating (113) than the methanol blends (107) used previously. The octane rating of gasoline measures the ability of the fuel to resist being ignited by the heat and pressure caused by compression (preignition or knocking/pinging). Preignition can rob the engine of its power. A higher octane rating indicates a higher-performing fuel.

Team Ethanol in the lead

The ethanol industry itself sponsors a car in the IndyCar Series – the #17 Rahal Letterman Racing Team Ethanol Honda/Dallara/Firestone. ICM, Poet, and Fagen, Inc. are the primary sponsors of Team Ethanol. Novozymes is also a proud and active participant in the program.

2008 has been a very good year for Novozymes and Team Ethanol. Thanks to the excellent driving skills of Ryan Hunter-Reay, on July 6 Team Ethanol enjoyed its first IndyCar Series victory at the Camping World Grand Prix in Watkins Glen, New York.

Joining in the fun

Although the IndyCar Series was the first to use ethanol blends and then 100% ethanol, others are quickly following suit. The American Le Mans Series, Sprint Car Series, Fun Car Series, and the Modified Series are also on the way.

So the message is not only clear but powerful: If a 650-horsepower IndyCar Series car, which can cover the length of a football field in 1 second, can run safely and effectively on 100% ethanol, then your vehicle can run well using an ethanol blend. Next time you are at the pump try choosing an E10 or E85 blend. ■

NOVOZYMES A/S

Krogshøjvej 36
2880 Bagsvaerd
Denmark
Tel. +45 4446 0000
Fax +45 4446 9999
www.biotimes.com

FOR MORE INFORMATION

Jack Rogers
jckr@novozymes.com