PRESS RELEASE

Novus celebrates anniversary this month, planning for a long future

What three decades in agriculture means for the feed additive company

SAINT CHARLES, MO (June 1, 2021) – On June 6, Novus celebrates 30 years of supporting animal protein producers globally who are working to feed the world.

In 1991, Novus International, Inc. was founded with a mission "to make a clear difference in sustainability meeting the growing global need for nutrition and health." The outcome of Novus's mission statement is clear – the availability of healthy and affordable animal protein can positively impact populations, particularly when produced with regard for environmental impacts, feed costs and animal performance. Looking back at the last three decades, Novus President and CEO Dan Meagher said the company has always endeavored to offer solutions for the industry's biggest challenges.

"Achieving performance and profit goals while optimizing animal health are challenges for every producer regardless of operation size," he said. "There are many purposes for feed additives. For us, the purpose is to ensure the nutrients in raw feed are available to the animal, support the animal's gut health to optimize the nutrition it receives from the feed, and to provide the animal with what it can't get from raw feed materials to better prepare it for the health challenges it may encounter during its life. Regardless of the products we've offered over the years, focus on these objectives is how Novus helps its customers globally."

Novus's foundation began with methionine. In a joint partnership established in 1991, Mitsui & Co., Ltd., and Nippon Soda Co., Ltd., acquired the rights to ALIMET® feed supplement and SANTOQUIN® feed preservative*, creating the company with a source of methionine as its flagship product. From there, methionine solutions MHA® feed supplement and MFP® feed supplement were added to the portfolio. Novus's next innovation was the MINTREX® trace minerals line, which includes organic sources of zinc, copper and manganese bonded to the HMTBa (hydroxy methionine analogue) molecule allowing for better absorption and mineral availability. ACIDOMATRIX™ feed additive and ACTIVATE® nutritional feed acid, both offering combinations of organic acids and HMTBa, were created for the eubiotics portfolio. Other organic acids, essential oils and the CIBENZA® enzyme platform were added, as were pigment and feed quality products before being sold to EW Nutrition earlier this year. The sale was part of a re-focusing currently underway for the company: its Project Destiny strategic business transformation, which includes the goal of becoming the industry's go-to source for gut health nutrition solutions.

"Food production is changing with a strong focus on sustainability, animal welfare/health, efficiency, and other drivers directly related to gut health," said David Dowell, executive vice president and chief operating officer. "Health through nutrition has been a long-time principle in human health and Novus wants to expand our solutions in the key area of growth for our industry."

As part of the renewed focus on innovation, Novus announced its partnership with biotechnology company Agrivida Inc. to develop an innovation pipeline of products using INTERIUS™ Technology; the first in-grain-based feed additive platform commercially available to animal nutritionists and

feed formulators. Novus is also working to commercialize the flagship product GRAINZYME® PHOS phytase which uses the technology to produce the enzyme inside corn kernels, thus eliminating processes and costs in feed production.

“As a part of this industry, it’s important that we’re aware of the resources we use. Expressing feed additives directly inside grain is an exciting way to do more with less,” said Chief Innovation Officer Al Zimmerman.

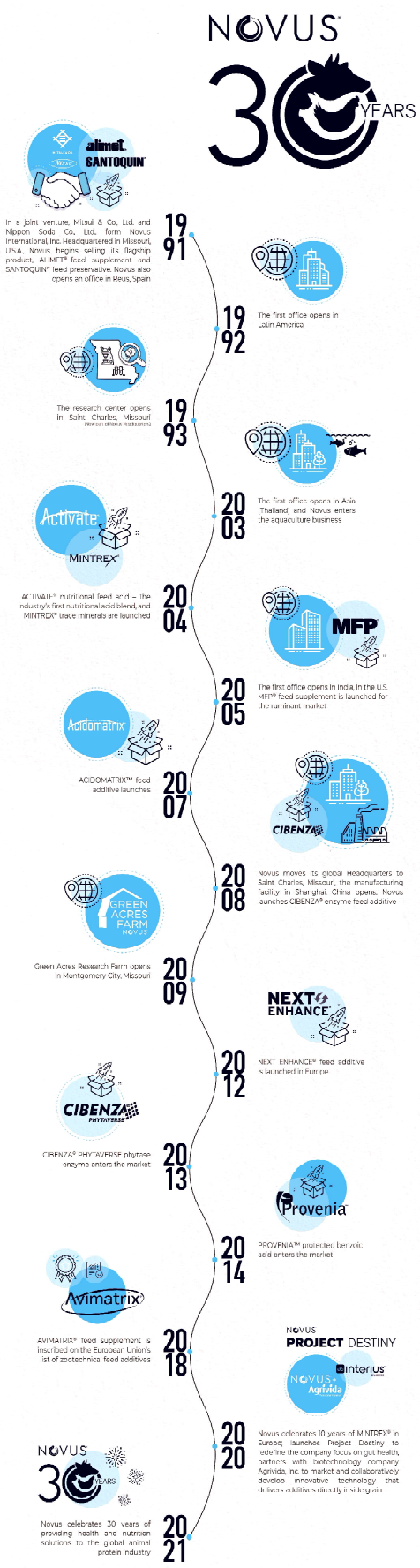
Doing more with less also applies to the company’s commemoration of its anniversary. Since the pandemic is prohibiting Novus from celebrating in-person, it is taking the message to the web. During the upcoming months Novus social media followers will see video and images on what 30 years means for those closest to the company – its employees.

“There’s nothing I would like more than to take a world tour to celebrate this anniversary with every employee but that’s just not feasible,” Meagher said. “We’re having a toned-down, socially-distant anniversary instead, which is really unfortunate since the employees are the reason for Novus’s success. We have hard-working, dedicated, intelligent people at every level of our company, and they each deserve a standing ovation.”

Vice President and Chief Human Resources Officer Maria Burt echoed Meagher’s statement on the need to celebrate all that employees have achieved, particularly during the pandemic.

“Our colleagues have gone above and beyond in so many ways throughout the pandemic. All of those challenges, coupled with big changes in our company, would have been daunting for anyone, but they have shown their commitment, ingenuity and grit through it all. They are a truly excellent group,” she said.

What will the next 30 years look like? Meagher said Project Destiny is paving the way for a Novus known more for its partnerships with customers than its product line.



"There's no question that our solutions – methionine, minerals, enzymes, organic acids, essential oils – can help our customers with their operations but we want to be more than that. Our goal is for customers to look at Novus as a trusted advisor that is going to help make their business more sustainable financially and environmentally."

The new goals and direction of the company are wholly supported and commended by Novus's Board of Directors. In a statement, Tetsu Watanabe, Novus chairman of the board and senior vice president of Mitsui & Co. (U.S.A.), Inc., congratulated Novus employees on the 30th anniversary and said the Board is eager to see what comes next.

"Since its formation, Novus has been an integral part of our strategy and we have worked hand-in-hand with Novus to help 'Feed the World'," he said. "As always, we fully support the transformation and growth of Novus as it endeavors to be the provider of viable solutions for the industry. We are pleased to see that the organization is going down the right path."

Learn more about Novus at www.novusint.com.

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Novus International, Inc. is a leader in scientifically developing, manufacturing and commercializing gut health solutions for the agriculture industry. Novus's portfolio includes ALIMET® and MHA® feed supplements, MINTREX® chelated trace minerals, CIBENZA® enzyme feed additives, NEXT ENHANCE® feed additive, ACTIVATE® nutritional feed acid, and other products. GRAINZYME® PHOS phytase is owned by Agrivida Inc. Novus is privately owned by Mitsui & Co., Ltd. and Nippon Soda Co., Ltd. Headquartered in Saint Charles, Missouri, U.S.A., Novus serves customers around the world. For more information, visit www.novusint.com.

PRESS RELEASE

NOVUS

Trypsin Inhibitor, the hidden enemy in Soyabean Meal

Dr. Koushik De, *Director-Technical Services, SCA, Novus International*

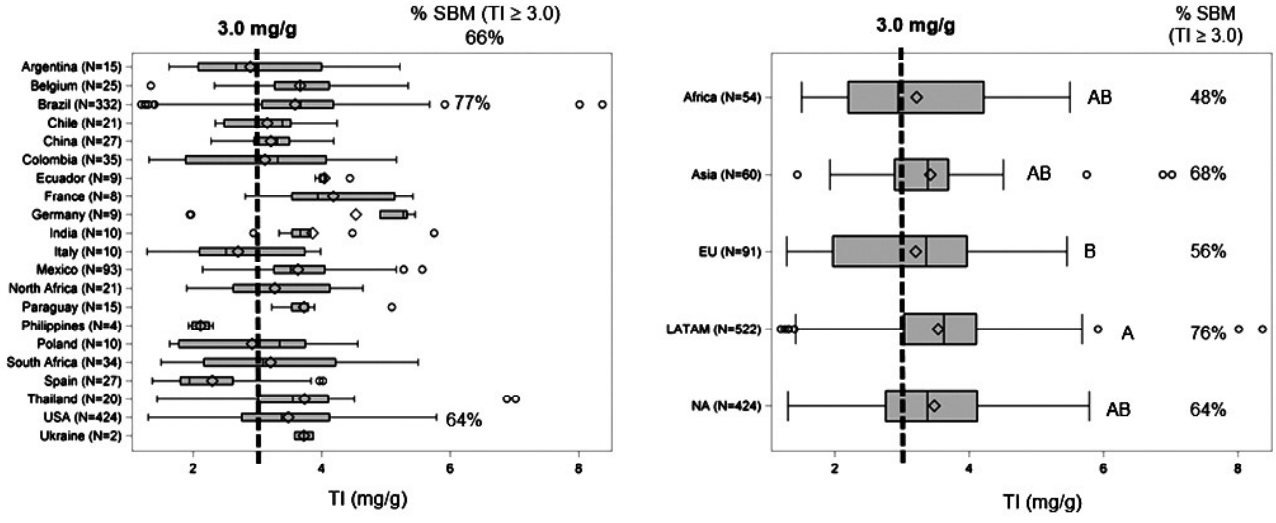
Dr. Koushik De

As global animal production has rapidly shifted towards reduced Antibiotic free, "Gut health" has become a popular expression and all-encompassing concept in the scientific community. The gastro-intestinal tract must provide a barrier function protecting against harmful environmental elements (e.g. toxins and pathogenic microbes), while simultaneously permitting appropriate nutrient absorption. Successful animal performance depends on the interplay between the intestine, microbiota, diet, and a multitude of environmental factors.

The shift to antibiotic free production or better gut health often results in the increase of soybean meal inclusion as there are limited in the number of efficacious protein sources that successfully reduce soybean meal content. Soybean meal is the most widely used major protein source in poultry production across the world. However, SBM contains various anti-nutritional factors that may affect intestinal homeostasis and impair nutrient utilization in poultry. The main anti-nutritional factors in SBM, are trypsin inhibitors (TI), oligosaccha-rides, such as raffinose and stachyose, and the antigen Glycinin, β-conglycinin and Lectins. Diets that include high levels of soybean meal contain proportionally higher anti-nutritional factors and may pose the risk of impaired performance.

Chen et al. (2016) analyzed the content of TI and Urease Activity (UA) in more than 1000 samples of SBM from all over the world and observed a high degree of variability in the reported ANF values, both within the same country and amongst different origins.

The levels of trypsin inhibitor (TI) of solvent-extracted soybean meal samples from different countries and world areas.



Chen et. al., The Journal of the American Oil Chemists' Society, 2020

The elevated variability and its potential negative impact on performance highlights the importance of knowing the content of anti-nutritional factors in SBM for poultry formulations.

In this article, we will review mainly the role of Trypsin Inhibitors (TI) in broilers.

Why Should we care about TI?

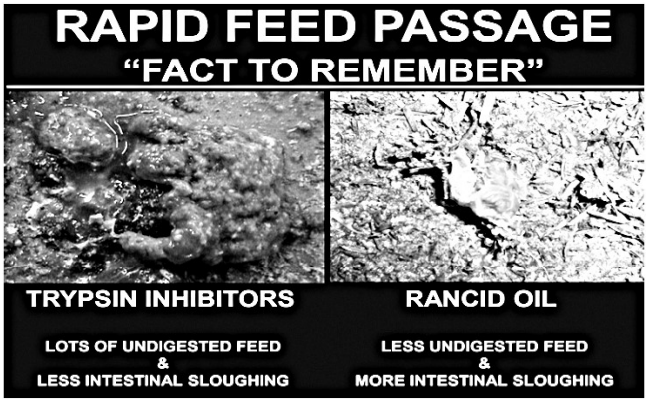
Trypsin and chymotrypsin are important digestive enzymes that are secreted by the pancreas as the inactive enzyme precursors trypsinogen and chymotrypsinogen. Trypsin activates itself via positive feedback and converts chymotrypsinogen and other inactive enzymes into their active forms. As Tis are protein in nature and one of the most anti nutritional components of SBM, they compete to bind to trypsin therefore affecting the digestion process. They have been correlated with rapid feed passage and decrease in digestibility of broilers with a relevant economic impact. The analysis is still more expensive, complex and time consuming for TI, for this reason, other parameters are commercially used as indirect SBM quality indicators, such as Urease activity and Protein solubility.

There are two types of TI present in Soya, Kunitz TI which is larger molecule & Bowman-Birk TI which is smaller molecule. But soyabean seed contain around 14% more Bowman Birk TI than Kunitz TI.

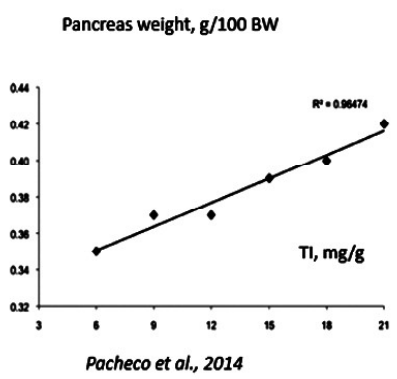
Consequence of TI for Soya Bean and bird performance:

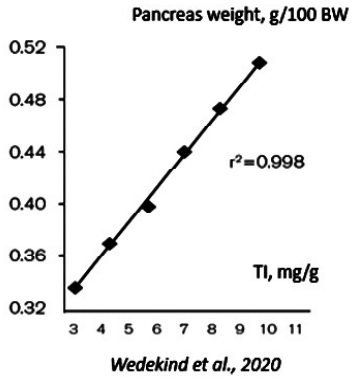
Excessive quantities of TI in feed will cause pancreatic hypertrophy leading to poor growth and decreased performance (Pacheco et al. 2014; García-Rebollar et al. 2016; Rada et al. 2017). This pancreatic hypertrophy is a compensatory modulation by the body to offset the effect of ingested trypsin inhibitors (Liener 1981; Waldroup et al. 1985).

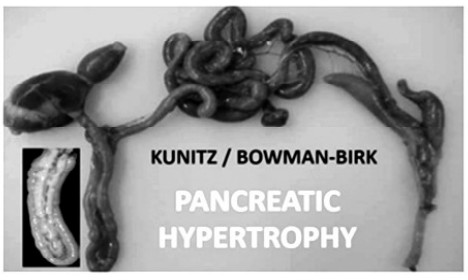
TI also affect the nutritive value of SBM. Because of loss of endogenous protein there is reduced digestion which affects the nitrogen balance, gut viscosity resulting into reduced live weight and negative impact on feed efficiency. Palliyeguru et al. (2011) demonstrated dietary soya TI elicited an increased severity of sub-clinical necrotic enteritis. When amino acid digestibility is compromised, the ileal ingesta will have a relatively high content of undigested amino acids that pass into the large intestine and cecal tonsils, where microbial fermentation will occur. *C. perfringens*, a pathogenic agent of necrotic enteritis, needs specific amino acids and peptides for its proliferation (Nakamura et al., 1968).



Linear increase in pancreas size with increasing TI content in SB

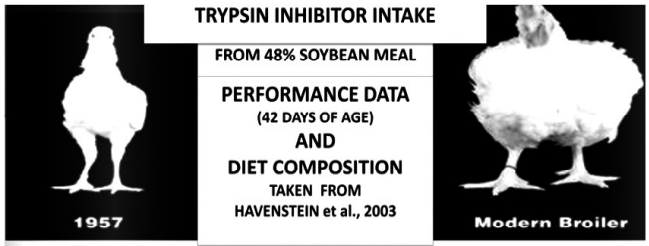






Erdaw et al., 2018: "Anti-nutrients Reduce Poultry Productivity: Influence of Trypsin Inhibitors on pancreas"

Using the Data from the simulation conducted by Havenstein et al.(2003) with "1957" broilers versus '2001" broiler it is possible to estimate the TI intake of the "1957" birds fed 1957 diets and compare it with the estimate of TI intake by the "2001" birds fed 2001 diets.



	AVERAGE BODY WT ♀	AVERAGE FEED INTAKE (g)	TI CONTENT IN SBM (mg/g)	AVERAGE DIET TI CONTENT (mg/g)	AVERAGE CUMULATIVE TI INTAKE (mg/BIRD)
1957	539	1261	2	0.476	600
			4	0.952	1200
			6	1.428	1800
2001	2672	4355	2		2007
			4		4014
			6		6021

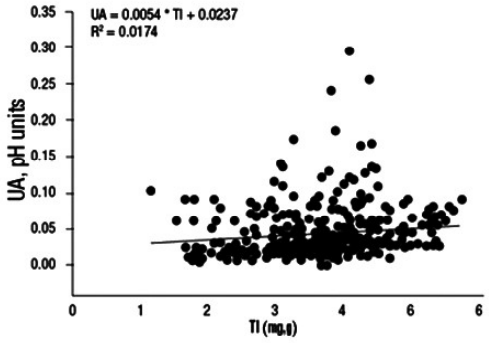
Because of improvement of modern broilers in terms of average feed intake and body weight they consume more than three times TI than 1957 birds considering the same amount of TI in SBM.

The effects of TIA are particularly strong in young animals. It has been shown that overcooking of soybean meal decreases digestibility of amino acids (Lee and Garlich, 1992; Parsons et al., 1992). The explanation for the decreased amino acid digestibility and reduced growth responses appear to be related to the Maillard reaction with cross-linking involved to a lesser extent.

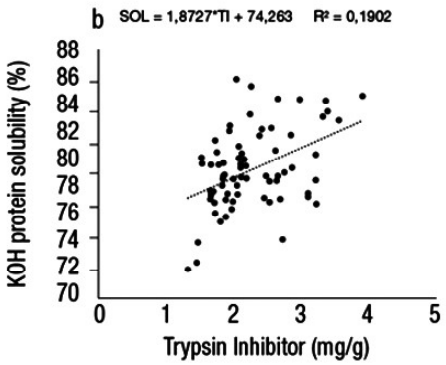
Correlation of TI (AOAC) & indirect Parameters for SBM quality:

Currently, the analytical technique most commonly used to measure soybean meal quality is protein solubility, perhaps combined with the urease test. The urease test has been used for some time as a measure of soybean meal processing. Trypsin inhibitors (TI) and urease activity (UA) are the two most relevant quality measurements for soybean products as feed ingredients for animals. TI were reported to be correlated with UA, so feed processing plants use UA as an indicator of TI in soybean meal (SBM). Chen et.al (2019) conducted a study to determine the levels of TI and UA in 414 SBM samples from 19 different countries and to validate whether TI and UA are correlated. They found that TI were poorly correlated with UA in solvent extracted SBM samples, suggesting that UA should not be used as a surrogate indicator for TI content in soybean products.

➢ 414 SBM samples / 19 countries



➢ 70 SBM samples / Brazil



Recent studies shown poor correlation between TI and Urease Activity and a better but still poor correlation between TI and solubility

Araujo et al. 2019 Chen et al. 2019

Araujo et al (2019) conducted similar study to determine the correlation of TI and KOH Protein Solubility.

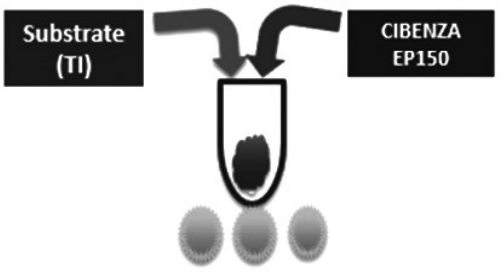
Analytical characteristics of common types of soy protein products

Product type	Unit	Soybean seeds	SBM	Enzyme treated SPC	Alcohol extracted SPC	SPI
Humidity	%	10 - 12	10 - 12	6 - 7	6 - 7	6 - 7
Crude protein	%	33 - 17	42 - 50	55 - 60	63 - 67	>85
Fat	%	17 - 20	0.9 - 3.5	2.5	0.5 - 3.0	0.1 - 1.5
Ash	%	4.5 -5.5	4.5 - 6.5	6.2 - 6.8	4.8 - 6.0	2 - 3.5
Oligosacharides	%	14	15	<1	<3.5	<0.4
Stachyose	%	4 - 4.5	4.5 - 5	<0.3	1 - 3	<0.2
Raffinose	%	0.8 - 1	1 - 1.2	<0.2	<0.2	<0.1
Trypsin inhibitor TIA	mg/g CP	45 - 60	4 - 8	1 - 2	2 - 3	<1
Glycinin	mg/g	150 - 200	40 - 70	<0.1	<0.1	<0.01
ß-conglycin	mg/g	50 - 100	10 - 40	<0.1	<0.1	<0.005
Lectins	ppm	50 - 200	50 - 200	<1	<1	<1
Saponins	%	0.5	0.6	0	0	0
Phytic acid bound	%	0.6	0.6	0.6	0.6	-

SBM = defatted soybean meal; SPC = soy protein concentrate; SPI = soy protein isolate.
Adapted from: Hansen (2003) and Peisker (2001)

How to deal with TI in SBM?

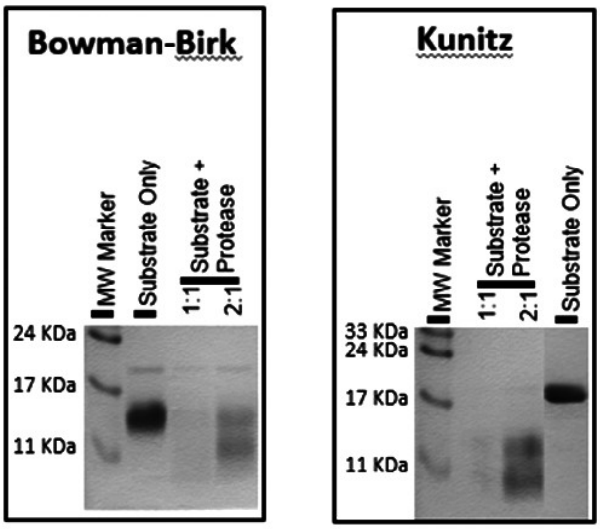
Soybean meal (SBM) is the most important source of dietary protein for poultry. Although TI is reduced by heat treatment, overheating has a negative impact on protein quality and amino acid digestibility. Exogenous Protease enzymes can improve digestibility of feedstuffs, lower feed costs and improve animal performance. Proteases



TI: CIBENZA EP150	Trypsin inhibitor (µg) - substrate	CIBENZA EP150 (µg)
1:0	15	0
1:1	15	15
2:1	15	7.5

THE UNIVERSITY OF SYDNEY

Liu 2013



In vitro degradation of TI with CIBENZA EP150
KDa = molecular mass of the TI

CIBENZA® EP150 can destroy almost all trypsin inhibitors present in soyabean meal (at 1:1 ratio) and destroy substancially even in higher concentración (2:1) of TI as well

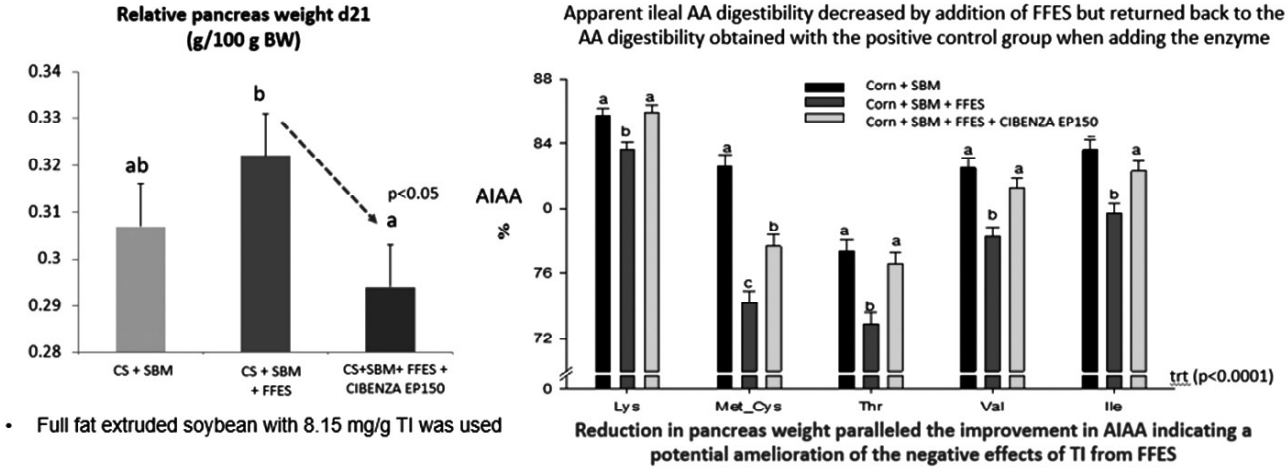
improve animal performance and nutrient digestibility by decreasing digesta viscosity, improving endogenous enzyme activity and decreasing pancreas weight (Bedford and Classen, 1993; Bedford and Schulze, 1998; Erdaw et al., 2017a,b; Yan et al., 2017).

As mentioned earlier the determination in the laboratory of the TI content of SBM and its relationship with AA availability is tedious and time-consuming and provides inconsistent results. Also, the traditional processes of treating SBM can't remove the anti-nutritional factors to a safe level. Therefore, use of exogenous protease is very effective in reducing the deleterious effect of TI in SBM. *Liu et al.,* in 2013 conducted a study wherein they used a protease enzyme (Cibenza EP150) with different levels of TI and found that protease enzyme was able to destroy almost all trypsin inhibitors (both Bowman-Birk & Kunitz TI) present in soyabean meal (at 1:1 ratio) and destroy substancially even in higher concentración (2:1) of TI as well.

Wedekind et al., in 2020 showed that addition of exogenous protease (Cibenza EP150) in a diet containing FFS(with TI 8.15mg/g) improved the amino acid digestibility and at the same time reduce the pancreas weight also indicating a potential amelioration of the negative effect of TI from FFS.

Conclusion:

There are lot of scientific evidences on the negative effect of soybean trypsin inhibitors in chickens. They can not only adversely affect the productive performance of chickens but can also impair their intestinal health. The beneficial responses of protease are likely due to decreases in endogenous amino acid losses, but in vitro evidence also demonstrates the ability of protease to hydrolyze Bowman-Birk and Kunitz-trypsin inhibitor proteins. Thus, there might be both direct and indirect mechanisms whereby amino acid digestibility is improved with proteases and so is the bird's performances.



Wedekind et al., 2020