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Evaluation of Absorbezz on Swine Reproductive Health and A Comparative Study of Two Commercially Available Swine Show Feeds

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Evaluation of Absorbezz® on Swine Reproductive Health and a Comparative Study of Two Commercially Available Show Pig Feeds

By

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ABSTRACT

The efficacy of a feed supplement fed to gilts and sows was tested in study I. The supplement was stated to improve reproductive soundness, conception rates, immune health, and overall well-being of livestock. Thirty gilts were split into a control group (Base diet) and a treatment group (Absorbezz® 0.32 mL on base diet). Upon completion of the trial results indicate the treatment group significantly underperformed (<0.05) when compared to the control group, thus disproving the hypothesis claimed by the feed supplement.

Two commercially available show pig growing rations were tested in study II to find a high quality, cost efficient product. A total of 10 pigs (5 barrows, 5 gilts), at an average weight of 60 lbs., were fed to market weight, with data recorded for feed efficiency and carcass quality. No significant differences (< 0.05) were discovered between the two rations. A larger sample size could adjust results.

ACKNOWLEDGEMENTS

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I extend my gratitude to the staff at the SFASU Swine Center for all the hard work and dedication it took to complete this project. Lastly, I would like to say thank you to Dr. Bray, Dr. Jones, and Dr. Oswald for their support and guidance through this academic accomplishment.

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INTRODUCTION

According to the National Pork Producers Council, the United States pork industry has a current gross profit of $23.4 billion. In the past 30 years, the pork industry has rapidly grown from many small farm operations to several corporate farms, while exponentially growing the national swine inventory to 68.4 million head as of June 2016 (USDA, 2016).

With confinement capacity being high and numerous viral pathogens being exposed every day, strengthening immune health has become of upmost importance for producers; therefore, the demand for more sustainable production has limited the progress of this issue. The latest crisis the industry faced was an epidemic outbreak of Porcine Epidemic Diarrhea Virus (PEDv) which was first noted in the United States in 2013. Research proved PEDv caused watery diarrhea with 50-100% morbidity in piglets up to one week of age and less severe symptoms in older sows. Less than eight weeks after initial diagnosis 12 states had cases of PEDv outbreaks and by June 2014, 30 states tested positive for PEDv (Alonso et al., 2014).

The commercial pig industry strives for production oriented females who can produce litters of 12-14 piglets which can provide a litter value up to $2,000, whereas in the show pig industry more terminal characteristics are selected such as more expressive muscling and masculinity. These characteristics are selected because boars and barrows are the focus of this industry as the barrows are sold to youth in 4-H and FFA to be shown across the nation, and the boars are raised and sold to boar stud operations where they are utilized for collection of semen and artificial insemination. The barrows can be sold off the farm for up to $25,000 and the highest selling boar to date was sold in 2015 for $380,000, so it can be justified that the females in the show industry produce smaller litters than their counterparts in the commercial industry as the potential for a higher selling pig is greater.

Gilts are viewed as a necessary evil in the industry as they typically are harder to breed, require closer management, have higher risk for disease transmission, and farrow fewer piglets (McCaw, 2000). On average, gilts make up 25% of the herd and it is therefore vital to improve their health, reproductive soundness, and increase the conception rate (Kaneko and Koketsu, 2011).

Feed efficiency and average daily gain generally go hand in hand: feed efficiency is defined as the amount of feed intake by an animal to attain one pound of gain, while average daily gain is the average weight gained by an animal within one day. Across the meat industries, poultry have the highest feed conversion at 2:1 (2 lbs. feed/ 1 lb. gain), swine have a 3:1 feed conversion ratio (3 lbs. feed/ 1 lb. of gain), and beef have a 6:1 ratio. The need for a higher average daily gain is crucial to an industry that consistently feeds growing hogs to market weight at six months of age or less. On average, feed costs account for 60-70% of total costs in swine production, and it costs approximately $75 to feed a hog to market weight. As of August 28, 2016, the national average price per live hog was $47.40/cwt, meaning a 260 lb. hog would market at $123, allotting the producer approximately $50 profit less water, electricity, and labor. Thus, increasing the average daily gain and lessening the duration animals are on feed becomes increasingly paramount to pork producers.

This research project was divided into two studies. The first study aimed to explain the efficacy of Absorbezz® added to the rations of a sample size of 30 female pigs provided by the Stephen F. Austin State University (SFASU) Swine Center. Absorbezz® contains a proprietary blend of complex ionic minerals, trace minerals, calcium carbonate, and mastic gum. The claim of the additive was to improve problems of reproduction soundness, increase conception rates, increase milking ability, aid in immune health of neonatal piglets, and provide accelerated weight gain. The second study enrolled 10 feeder pigs who were provided two separate commercially available show pig rations. They were fed to market weight and processed to have carcass quality further inspected to determine the more efficient feed.

OBJECTIVES

Study I

1. The effect the supplement had on conception rates.
2. The effect the supplement had throughout gestation.
3. The effects the supplement had on birth weight, weaning weight, total born, and number born alive.
4. The period of time it took for return to estrus in the first parity gilts and sows

Study II

1. The rate of gain and feed efficiency.
2. A comparison of the carcass quality of the hogs post processing.

LITERATURE REVIEW

The Absorbezz® proprietary blend contains complex ionic minerals, trace minerals and mastic gum. The analytical composition includes 69% chloride (Cl), 28% magnesium (Mg), 1% sodium (Na) and <1% potassium (K). Absorbezz® is manufactured by Absorbezz® LLC. located in Fort Lauderdale, Florida. It is marketed as a premier livestock feed supplement. Since human and swine gastrointestinal tracts are very similar, many of the studies that have been done with mastic gum are primarily pharmaceutical and practiced on human trials.

Ionic Minerals

An ionic mineral is one that has either a positive or negative charge on the molecular level, and this unstable state of the mineral allows it to assimilate or be utilized by the organism ingesting it. Ionic minerals play a vital role, as structural materials, constituents of the soft tissues and cells, and regulate many of the biological processes. They occur naturally in feed, but quality, amount, andbioavailability can vary considerably (Acda, 2002). A number of these ionic minerals such as zinc, copper, and manganese, are co-factors for numerous different enzymes and transcription factors (Richards et al., 2010). Minerals also aid in the transport of oxygen to the body, aid in assimilation of other nutrients, and form building blocks for amino acids, hormones, and protein, also acting as antioxidants. If trace minerals are consumed in proper ratios, they have a profound effect on both human and animal's health.

Absorbezz® contains essential ionic and trace minerals consisting of; Chlorine (Cl), Magnesium (Mg), Sodium (Na) and Potassium (K). One advantage of the supplements chelated trace minerals is the binding of the organic ligands to the mineral should provide the stability of the complex in the upper gastrointestinal system and allow the complex to be delivered to the absorptive section of the small intestine for mineral absorption (Richards, 2010). These trace minerals may be used to aid in immune system development, tissue development, tissue strength, and the inner linings of the gastrointestinal system.

<u>Essential Minerals</u>

Before swine production became industrialized, many small farm operations had a small herd of pigs who grazed in an open field. This field provided almost all the mineral requirements a sow would need just from the soil. With the industrialization of swine production nearly all operations have moved to confinement operations, which limit the mineral availability to the sows. Therefore, supplementation is required. This has led to most feeds having a balanced mineral package supplemented to the ration to meet the requirements of the sows. There are 14 essential minerals considered for swine nutrition. Of these, magnesium, sodium, calcium, chlorine, phosphorous, and potassium are referred to as macro minerals because they are needed in much larger quantities in the daily diet requirements. Most macro mineral deficiencies occur in growing pigs rather than in gilts or sows during pregnancies (Koketsu et al., 1996). It is expected that the mineral package of the proposed feed and top dress supplement will help aid the treatment groups in improve conception rates, improve health through gestation, increase total born, increase number born alive, improve weaning weights, and shorten the period of time for return to estrous during the feeding trials of this experiment as they will contain higher levels of the macro minerals.

Mastic Gum

Mastic gum is also known as Chios Mastiha and it originates from the Mastiha tree. The Masthia tree (*PistaciaLentiscus var. Chia*) is an evergreen shrub, develops slowly, and matures after 40-50 years. At maturity it stands around five meters and tends to have a life span of more than 100 years. However, it generally only produces mastiha from the fifth or sixth year of its life and reaches its maximum yield after its fifteenth year. Chios Mastiha is the resinous excretion of the Mastiha tree and it is excreted in form of teardrops from the trunk and large branches through cuts on the surface by sharp tools (Association, 2014).

Mastiha usually remains under the shrub until it solidifies: it will take about 20 days to solidify depending on the weather conditions. In the summer, the determining factors: sunlight and the humidity rate of the environment. The color of the Chios Mastiha is initially ivory-like, but within 12-18 months the color changes yellow due to oxidation. After 70 years of age, the mastic tree yield regresses significantly; however, its average annual yield by tree ranges from 150-180 grams of mastiha. In rare cases, the trees will yield up to two kilograms while others may produce just 10 grams. The male trees are cultivated often due to their productivity. However, distance between trees may also effect yields (Association, 2014).

The exact composition of Chios Mastiha is not yet known. Its unique resin consists of an exceptional variety of therapeutic and aromatic ingredients. These include natural polymer, volatile and aromatic ingredients which constitute the essential oil, Mastiha oil, terpenic acids, phytosterols, polyphenolic molecules and a large number other ingredients which are unique with this species. A combination of over 80 ingredients can be found in Chios Mastiha which demonstrates its many uses. Mastiha is now used in the food and health industry, as well as the individual care sector worldwide (Association, 2014). In 1997, Chios Mastiha was characterized as a Product of Protected Designation of Origin (PDO) by the European Union (EU). Documents show in the ancient world, mastic gum was used primarily as a natural chewing gum to clean the teeth and provide freshness of breath.

Antimicrobial Properties

According to Dimas et al. (2012), in a study conducted in 1980, Chios Mastiha gum was a potential agent for the treatment of duodenal ulcer in humans. The test was conducted with a double-blind clinical trial on 38 patients with symptomatic and endoscopically proven duodenal ulcer to compare the therapeutic responses with Chios Mastiha (1 gram daily, 20 patients) and placebo (lactose, 1 gram daily, 18 patients). The doses were given orally for a period of two weeks. Symptomatic relief was found in 16 (80%) patients on Chios Mastiha gum and in 9 (50%) patients on placebo. Additionally, endoscopically healing occurred in 14 (70%) patients on Chios Mastic gum and four (22%) patients on placebo. These treatments differences were highly significant and the Chios Mastic gum was well tolerated and did not produce any side effects. Therefore it was concluded that Chios Mastic gum had a healing effect on ulcers.

Nahida et al. (2012) reported *Pistacialentiscus L*. was found to be effective against *Sarcinalutea*, *Staphylococcus aureus*, and *E. coli*. It also has an antimycotic activity. The oil obtained from the leaves, twigs, and mastic gum by steam distillation aids in-vitro antimicrobial activity, and antifungal activity against rhizoctaniasolani. The aqueous and flavonoid enriched extract and essential oil from leaves demonstrated inhibitory effect against *Salmonella typhimurium* and lower inhibitory effect against *Staphylococcus aureus*, *Pseudomonas seruginosa*, and *Salmonella enteritidis*. The oil from the mastic gum is also effective against

Gram positive and Gram negative bacteria such as *Staphylococcus aureus*, *Lactobacillus plantarum*, *Pseudomonas flagi*, and *Salmonella enteritis* in broth and in a model food system.

Treatments of Patients with Dyspepsia

According to Dimas et al. (2012), dyspepsia is a common term used for heterogeneous group of abdominal symptoms. In functional dyspepsia (FD) multiple mechanisms such as abdominal gastric emptying, visceral hypersensitivity, impaired gastric accommodation, and central nervous system are involved. Although the possibilities of pharmacological therapy for FD are still limited, herbal remedies are becoming increasingly popular as a treatment measure for FD. A study was conducted with patient's fulfilling the criteria for FD, which were randomly selected to receive either CMG or placebo. The FD was assessed using the Hong Kong index of dyspepsia. The results showed a symptom score after the treatment to be significantly decreased in the CMG group than the placebo group. It showed an improvement of symptoms of 40% in patients receiving the placebo and 77% in patients receiving CMG. The test concluded that CMG significantly improves symptoms in patients with FD compared to those given the placebo.

Antioxidant and Anti-Inflammatory Properties

Dimas et al., (2012) reported a study stating patients with chronic inflammatory diseases such as cystic fibrosis, asthma, rheumatoid arthritis, systemic lupus erythematosus, psoriasis, and Crohn's disease (CD) have an increased risk of atherosclerotic. The study tested if Chios Mastic gum (CMG) would have an effect on the function of activated microphages. The results proved that both solid and liquid CMG inhibited the production of pro-inflammatory substances such as nitric oxide (NO) and prostaglandin (PGE_2) by lipopolysaccharide (LPS)-activated mouse macrophage-like RAW264.7 cells. A western blot and (RT-PCR) analyses showed that CMG inhibited the expression of inducible NO synthase (iNOS) and COX_{-2} at both the mRNA and protein level. The data collected showed that CMG inhibited the production of both NO and PGE_2 by activated macrophages through its cytotoxic action. The study further explained CMG inhibited protein kinase C, which attenuates the production of H_20_2 by NADPH oxidases and carrageenan-induced statistical significant edema. This supported the suggestion that CMG could be used as an anti-inflammatory and antioxidant agent.

There are several continuing studies concerning the anticancer activity of Mastiha. Prostate and colorectal cancer is among those upon which the effects of Mastiha have also been researched more extensively. In 2006, a study showed Mastiha effects the function of prostate cells androgen receptors by inhibiting in-vitro the receptor's expression both on the mRNA and the protein level, setting the bases for the hypothesis of Mastiha's potential prostate anti-cancer activity. In 2007, the same research group showed Mastiha induces the expression of maspin, both on the mRNA and the protein level, and conclude that Mastiha could constitute an important factor against prostate cancer. The *in-vivo* activity of the hexane extract of Mastiha was tested against human colon tumor in immunodeficient mice (Dimas et al., 2012). The results showed Mastiha hexane extract administered at a dose of 200mg/kg daily for four consecutive days inhibited tumor growth by approximately 35% in the absence of toxicity possesses antitumor activity against human colorectal cancer under the experimental conditions of this study.

Porcine Respiratory and Reproductive Syndrome

Porcine Respiratory and Reproductive Syndrome (PRRS) is the most costly disease contracted by swine. According to the American Association of Swine Veterinarians, this disease cost the industry $664 million in 2015 alone. The economic loss arises from problematic late term reproductive failure and respiratory illness in neonatal piglets (Lopez et al., 2007). Porcine Reproductive and Respiratory Syndrome is classified as a single stranded positive sense RNA arterivirus responsible for causing low conception rates, late term abortions, still born and weak piglets born from sows. Respiratory distress caused by this disease can result in high mortality, fever, and lethargy in suckling, growing, and feeding pigs (Christopher-Hennings et al.,1995).

There are at least 24 different serovars or strains and two different genotypes of the virus, which make it very difficult to prevent or treat specifically for the disease. Innate and acquired immunity are the two types of responses the body has to fight off invading bacteria. Innate immunity is considered the first line of defense where the macrophages, cytokines, and granulocytes are the first to act. This stage of immunity is usually short lived but fast acting, whereas acquired immunity is long lived but slower acting. Acquired immunity consists of the helper T and B cells, along with cytokines and neutralizing antibodies. In the immune system the alveolar macrophages are the main cell in the lung's defense, and the primary target for the PRRS virus. However, PRRS actually enters the body and closely simulates the body's natural immune defense system of cytokines, T and B helper cells and attaches itself to the macrophages (Mateau et al., 2008). Once attached, the virus can replicate in the subset of the alveolar macrophage with the ability to phagocytize bacteria, and they will eventually attack and kill the macrophage and infection begins. PRRS can kill infected and non-infected macrophages by inducing necrosis, and reduce the bactericidal effects. Porcine Respiratory and Reproductive Syndrome will inhibit broad antiviral properties in the cytokines and produce an imbalance of pro- and anti- inflammatory cytokines in the immune system. All of these effects the PRRS virus has on the immune system can reduce the macrophage level in the immune system by >40% which can allow other coinfections to occur (Merck, 2015).

Pathogenesis

Porcine Respiratory and Reproductive Syndrome consists of 24 serovars and two main genotypes Type 1 and Type 2. Type 1 consists of the respiratory side effects of the virus and Type 2 will affect the reproductive processes in the pigs. Typically, with Type 1 anorexia, lethargy, red patches and blueing of the extremities are observed. This is also where the Blue Ear Disease term derived from symptoms exhibited in the early days of the virus. The pigs will show signs of severe fever (up to 106° F), dyspnea, tachypnea, splayed posture in juvenile pigs, and swelling of the conjunctiva (Amdori and Razzuoli, 2014). Type 2 PRRSV primarily effects gilts and sows and will generally develop where the virus affects their reproduction process, and often signs are early abortion, high mortality, and short litters. Type 2 the most prevalent in North America, can cause fever and decreased appetite, along with a longer return to estrus. Pigs in different life cycle stages are affected by the virus differently; young piglets and growing pigs tend to develop respiratory issues, whereas gilts and sows tend to have reproduction failure issues (Amdori and Razzuoli, 2014). Directly infected by the sow, unborn and nursing piglets can pick up the virus maternally. At 72 days of gestation the virus will cross the placental wall and infect the unborn piglets, and those born will soon develop respiratory failure if not monitored carefully. Growing pigs can become infected through many different transmission pathways, and once infected, the virus invades the lungs and attaches to the alveolar macrophages and begins to travel throughout the body, causing severe lesions in the lungs. With these lesions in place, it now has presented the immune system with the challenge of fighting off not only the PRRS virus but also many other respiratory viruses. The co-infections include but are not limited to: Swine Enzootic Pneumonia, varieties of *Streptococcus*, *Bordetella bronchiseptica*, Swine Influenza Virus, Aujeszky's Disease, and Porcine Circovirus. The list continues with more diseases the pigs can contract once infected. This list further proves how difficult PRRS can be to control and why it is so costly for the industry.

Reproductive issues are most common with gilts and sows but other co-infections can occur with PRRS. Gilts can also experience respiratory issues especially if they have not been introduced to the virus yet. Additionally, they will show signs of lethargy, inappetence, high fevers, blue discoloration of the extremities, subcutaneous edema. In some, if prolonged and untreated death may occur. Sows can generally go undetected of having the virus until later in gestation and sometimes, until farrowing. They will begin to have late term abortions, premature farrowing, increased number of mummified piglets, increase in still born piglets, and have a smaller total litter.

Another major side of the swine industry lies within the boars who keep it going. Porcine Respiratory and Reproductive Syndrome can affect boars, although the symptoms may not be severe the side effects and potential damage that can occur are significant. Symptoms in boars are generally a moderate fever, inappetance, lethargy, and lower semen counts. Once the virus dissipates in the body and these symptoms go away, the virus can stay alive in the semen for up to 90 days post infection and even longer if the boar's semen is collected and used for artificial insemination, since the semen is stored at low temperatures, just above freezing, which can actually help the virus stay alive (Donovan, 2011).

Porcine Parvovirus

According to the Merck Veterinary Manual, Porcine Parvovirus (PPV) is ubiquitous in pigs throughout the world. Unfortunately, it is a disease that puts first parity females at the highest risk of infection, which in turn leading to almost all females being naturally infected before their second pregnancy. PPV is classified as a small single stranded DNA virus belonging to the family *Parvoviridae* and has been well noticed for decades. As stated above, the virus is generally associated with reproductive failure resulting in higher number of mummified fetuses in breeding age females, and in younger growing pigs the virus results in some enteric disease and possibly dermatitis to follow (Opriessnig et al., 2014). According to the Iowa State College of Veterinary Medicine, during the acute phase of the PPV infection pregnant and infected sows will show signs of viremia. At that point, the virus can spread through the placental wall and infect the embryos or fetuses. If infection occurs in the first 35 days of gestation, death and resorption of embryos will occur and irregular estrus cycles and reduced litter sizes will also occur. Infection taking place 35 – 70 days during gestation will result in fetal death and mummification. The fetus is most likely to survive with no symptoms if infection occurs past day 70. Boars shed the virus by varying routes including semen, for a couple of weeks after acute infection and can introduce the virus into a herd (Merck, 2015). For biosecurity purposes at the SFASU Swine Center, the vaccination protocol calls for a killed Porcine Parvovirus vaccination for every sow after their litter is weaned. From that point the killed virus helps build the immunity for their next litter, and sows who are having conception issues are typically vaccinated every six months.

Porcine Epidemic Diarrhea

In 2013, a tragic virus hit the US swine industry called Porcine Epidemic Diarrhea (PEDv); this disease spread to over 17 different states and produced over 4,000 cases in less than a year (Trudeau et al., 2016). The PEDv outbreak resulted in an all-time low number of hogs produced and caused the market value to sky rocket. Porcine Epidemic Diarrhea Virus is a highly infectious coronavirus that is transmitted orally and causes severe entero-pathogenic diarrhea and is predominantly deadly for neonatal piglets, with a 90-95% mortality in suckling piglets (Bowman et al., 2015).The virus is considered to be a single-stranded, positive sense RNA group 1 Coronavirus that closely resembles Transmissible Gastro Enteritis (TGE). Porcine Epidemic Diarrhea Virus presents itself as acute watery diarrhea type symptoms with no blood or mucus in the feces; it has an approximate incubation period of 3 days, and can spread very rapidly across the herd and beyond. Porcine Epidemic Diarrhea Virus primarily replicates on the villi in the small intestine causing necrosis and degeneration of enterocytes, in turn, destroying and replacing with flat epithelial cells. Erosion and ulceration of enterocytes will lead to loss of tissue fluid in the lumen and inability to absorb adequate amounts of fluid through the intestine.

Gilt Development

Gilts make up almost 25% of any given breeding herd, hence their reproductive abilities can impact the overall herd performance (Kaneko and Koketsu, 2011). The onset of estrous among gilts compared to sows is relatively shorter, but can be sporadic. Providing a boar presence near the gilts can stimulate estrous cycling (Kaneko and Koketsu, 2011). Studies have reported that 8 - 29% of gilts do not farrow a litter (Christenson, 1986).

Reproductive failure is the leading cause of gilt removal from the herd, although upon examination the entire reproductive tract seems to be normal (Stalder et al., 2004). Low conception rates and dystocia are vital issues concerning gilts in the swine industry and the primary focuses of this research study. The gilts included in this study came from the show industry, where they were fed high protein diets, were pushed to be heavier muscled, and stouter structured than most in the commercial industry. The areas of more expressive muscle occur mostly in the loin and ham region of the body, and along with the added diameter of desired bone for the show pigs. This can narrow the pelvic area of the female and lead to issues with dystocia. These females are also pushed to reach a mature size much faster than normal which can affect when they will reach sexual maturity. The diets they are fed are designed to build muscle and then lay on fat to add to frame size, which can lead to animals being too fat to perform during conception.

Lysine

In the show pig industry there are many feed rations and feed companies. Some feed companies only have three rations, a starter, grower and finisher ration, while other companies have up to three different rations for each growing phase. Therefore, these companies find it essential to develop a feed that is feed efficient as well as cost efficient for the consumer.

Lysine is added to many swine rations especially grain-based diets as it is the limiting amino acid in those diets (Cromwell et al., 2011). Soybean and corn by products provided the largest quantity of lysine to the two rations utilized in the trial. Without added lysine, pigs cannot utilize the other essential amino acids for optimal performance (Cromwell et al., 2011). Lysine is utilized for maximum feed efficiency, protein accretion, and development of lean muscle. Several studies have been executed to determine proper levels of lysine in a diet, but not many have been performed to determine the most efficient level for show pig rations.

The varying lysine levels of the feeds utilized in this trial can be found in Appendix A and Appendix B. These different levels can give some outlook on efficient levels in show pig feed rations, and discover what is a more efficient lysine content in the feed.

METHODS OF STUDY

Study I

After careful analysis of the SFASU sow herd, there were only three sows that were not pregnant and two of those had recently farrowed, excluding the barren five. Therefore, the thought was that the study be utilized on the gilt herd only.

Experimental Animals

The SFASU Swine Center had 25 gilts and 5 barren sows that were put into production late fall and early winter of 2016. The gilts were all six months of age and were bred by artificial insemination from the beginning of August through September 15th. Many of those had been utilized as youth 4-H and FFA show projects and many may have had issues with conception due to high protein diets fed throughout the developmental period. There has been little study in this area, but word of mouth from breeders speculates some may never breed. Problems with reproductive diseases such as Porcine Reproductive and Respiratory Syndrome, Parvovirus, and others can also be an issue with the females who have been exposed to many different environments, people, and conditions. Gilts typically can have multiple issues after conception with litter size, piglet size, milking ability, dystocia, and return to estrus.

The five barren sows mentioned previously had produce one litter, but had failed to return to estrous, therefore in order to test the claims of Absorbezz® and mastic gum the sows were placed in the trial.

Gilts were housed in outdoor dirt pens at the SFASU Swine Center and had been broken into two treatment groups (Control and Treatment/Absorbezz®) then were place into three blocks, shown in (Table 1). The females were housed with a stocking density of five head per pen. The control group contained 10 gilts and the treatment groups contained the five barren sows and 15 gilts. Aside from the five females who had been identified with poor conception, the remaining gilts were randomly assigned to separate treatment groups, with uniformity in size and age in mind. Data collected on all females included conception rates, gestation length, number born alive (NBA), birth weight of piglets, mortality, weaning weight of piglets, and return to estrus interval.

Table 1. Gilt Treatment Groups Pens (T=Treatment; C=Control)

Block 1	Block 2	Block 3
T	C	T
C	T	T

<u>Statistical Analysis</u>

The experimental design of the study was a randomized block design. The data was analyzed using variance (ANOVA) for each block separately with four blocks. Duncan multiple range comparison were used to separate the treatment means with (<0.05). SAS (9.3) software was utilized to perform all statistical analysis (SAS Institute; Cary, NC).

Study II

Experimental Animals

This study was conducted to compare the result of two separate 18% protein, 6% fat feeds using both male and female pigs supplied by the SFASU Swine Center. For full detail of feed labels refer to Appendix A and Appendix B. A total of 10 pigs (5 barrows, 5 gilts) were selected at random to be in uniform groups with an average pen weight of 60 lbs. and then placed in two, 8'x 8' concrete floor pens at the Stephen F. Austin State University (SFASU) Swine Center noted in (Table 2). The pigs were fed *ad libitum* from a self-feeder and had automatic waterers in each pen. Feed A contained two barrows and three gilts, Feed B contained three barrows and two gilts. Randomly selected pigs were divided among the pens at a stocking density of five pigs per pen, and assigned to one of the treatment groups of either Feed A or Feed B. Pigs began the trial at similar ages and an average pen weight of 60 lbs. and reared on concrete until they reached 260 lbs.

Table 2. Feed Trial Group Pens (A= Feed A; B= Feed B)

	Block 1	Block 2	
Inside Wall	A	B	Outside Wall
8'	A	B	
	8'		

<u>Performance</u>

All pigs in each pen were weighed individually, for comparison, once a week throughout the duration of the study to an average pen weight of 260 pounds. The piglets were put on a weaning ration until 50 lbs. and then they were divided into treatment groups and fed with a self-feeder to market weight. The weights were analyzed to determine the average body weight in pounds, per treatment group. All feeds were weighed before and after consumption. The body weights and the average daily weight gain of the pigs were also compared. This process was to help determine if there is a significant difference between the two different feeds. All feed given to the pigs before and what was left during weighing was recorded. The data collected was utilized in calculating the total feed intake, feed conversion ratio (FCR). The result helped distinguish the state of the feed conversion rate between the control and treatment groups.

Harvest

Once all the feeding groups had reached marketable weight, the hogs were processed at the Texas A&M University Rosenthal Meat Laboratory. Carcasses were analyzed for dressing percentage, lean color, back fat depth at the 10th rib, last rib fat depth, loin-eye area, muscle score, USDA yield grade, percent lean, USDA quality grade, color score, marbling, firmness, loin pH, primal yields, overall lean cut out percentage, and carcass value.

A portion of the harvest data, liver and kidney weights were also measured to see if differences exist between treatment groups. The measurements were made based on a percentage of overall body weight for each hog processed.

Statistical Analysis

The experimental design of the study was a randomized block design. The data was analyzed using variance (ANOVA) for each block separately with 4 blocks. Duncan multiple range comparison were used to separate the treatment means (<0.05). SAS (9.3) software was utilized to perform all statistical analysis (SAS Institute; Cary, NC).

RESULTS

Study I

Gilt performance data was collected from their first parity, and evaluated on total born, total born alive, birth weight, weaning weight and return to estrous. Treatment 1 consisted of an industry standard 16% sow development ration with no added Absorbezz® and Treatment 2 consisted of the same ration with recommended dosage of .32mL of Absorbezz® top dressed at each feeding.

Reproductive Issues

Synchronization was difficult as seven of the gilts never cycled, one of which was from the control group and the other six were from the treatment group. Abortions were an issue as three gilts aborted two from the treatment group, and one from the control group. Gilt mortality became an issue throughout the trial as five gilts total were lost during parturition, two from the control and three from the treatment group. Most deaths during the trial were caused by issues with dystocia during the farrowing process, which was an anticipated concern due to summertime farrowing of show type gilts. Lastly, one female from the treatment group was unable to lactate post parturition and consequently her whole litter was recorded as a loss.

Table 3. Trial Complications

Issues		
Item	Control (n=10)	Treatment (n=25)
Synchronization	1	6
Abortion	1	2
Mortality	2	3
C- Section	1	1
No Milk	0	1
Total	5	13

Table 4. Absorbezz® Data Collected

Absorbezz® Collective Data			
Data Collected On	Control	Treatment	p-value
Total Born, pigs	11.10 (±.92)	7.00 (± .73)	<0.01
Total Born Alive, pigs	8.20 (±.85)	5.20 (±.68)	0.02
Birth Weight, lbs.	3.43 (±.24)	3.99 (±.19)	0.92
Weaning Weight, lbs.	8.59 (±.75)	8.34 (±.55)	0.51
Return to Estrous, days	7.60 (±.29)	5.10 (±.27)	<0.01

Total Born

Total born was calculated by counting the total number of piglets born alive, stillborn, and as mummies. The control group outperformed the treatment group with 11.1 (±0.92) piglets per litter as the treatment group only produced 7.0 (±0.73) piglets per litter (<0.05) as illustrated in (Table 4). The control group had a total of 7 out of 10 gilts that farrowed during the trial and treatment group that was fed the recommended dosage of Absorbezz® consisted of 11 out of 20 gilts in the group that farrowed.

Total Born Alive

The number of total piglets born alive was calculated at parturition by only considering the piglets that were viable, excluding stillborns and mummies. The treatment group produced a significantly lower number of total piglets born alive farrowing an average of 5.2 (±.68) live piglets per litter compared to the control group which farrowed 8.2 (±.85) live piglets per litter ($p<0.05$) displayed in (Table 4).

Birth Weight

As the gilts farrowed, the birth weight data was collected by weighing each individual piglet as it was born on a certified scale. Litter averages for the birth weights were also collected. Although there were no significant difference between the control and treatment group as shown in (Table 4), data shows the gilts with smaller litters had slightly larger birth weights than those in the control group who produced larger litters. This trend correlates with other studies throughout the industry that note that larger litters produce smaller piglets will be. This could provide fewer issues with dystocia (Kaneko and Koketsu, 2011).

Weaning Weight

After 21 days on the first parity gilt the piglets were weaned and weighed individually to compare weaning weights and average litter weights (Table 4). Again, no significant difference was noted for the data set, but the control group which had a lighter birth weight average weaned at a slightly heavier weight 8.59 (±0.75) lbs., compared to the treatment group which weaned at 8.34 (±.55) lbs. This result could be due to the fact that the lighter birth weight piglets were able to begin growing at a faster rate and the larger piglets were just slower maturing.

Return to Estrous

Once the piglets were weaned, the first parity gilts were returned outdoors and were monitored for signs of estrous. A significant difference was noted between the treatment and control group as the first parity gilts in the treatment group returned to estrous quicker than those in the control group. On average, the treatment group returned to estrous in 5.1 (±0.27) days whereas the control group took 7.6 (±0.29) days to return to estrous. Some studies have shown that larger and heavier litters can cause sows to have a slower return to estrous due to the stress the litter placed on the sow.

Barren Sows

In the beginning of the study there were five sows at the SFASU Swine Center who were considered barren or had failed to conceive previously. Of those five sows it was observed that two had successfully conceived and carried piglets to term. One sow only had four piglets born which had an average birth weight of 3.26 lbs. and an average weaning weight of 8.49 lbs. The other sow had seven total piglets born and only six born alive with an average birth weight of 3.86 lbs. and an average weaning weight of 8.6 lbs.

Study II

The feed comparison trial consisted of 10 male and female growing pigs that were split into two groups of five; Feed A (Appendix A) was comprised of two barrows and three gilts while Feed B (Appendix B) contained three barrows and two gilts all of which began the trial at a pen average of 60 lbs. and fed *ad libitum* for 16 weeks. For the feed comparison trial each pig was weighed weekly for 17 weeks to track average daily gain, average weekly gain, and feed efficiency. After 17 weeks, the group average was 250 lb. The two groups were sent to

Texas A&M University Rosenthal Meat Laboratory to be harvested and to collect carcass data. Data was collected on live weight, carcass weight, dressing percentage, last rib fat, 10th rib fat, and loin eye area. This trial was performed to test two commercially available show feeds in east Texas to see which provided the best results on the hoof and on the rail.

Feed Performance

Although the sample size was too small to show any significant difference between the two feeds, the trend from the data results show that Feed A did outperform Feed B throughout the 119 day trial. The total weight of feed was measured by weighing how much feed was placed into the feeders each time feed was added. The group who was fed Feed A consumed an average daily intake of 2.51 lbs. and finished the trial with an ADG of 1.78 lbs, as seen in (Table 5). Whereas, the group fed Feed B consumed an average of 2.49 lbs. per day and finished the trial at an ADG of 1.55 lbs.

Table 5. Feed Efficiency Comparison

Feed Efficiency (lbs.)	Feed A	Feed B	p<0.05
Total Weight	1408.6	1394.15	
Avg. Total Intake	281.72	278.83	
Avg. Daily Intake	2.515	2.49	
Avg. Daily Gain	1.785	1.558	0.1357
Feed Conversion	6.64	7.54	

Within Group A the barrows showed to have grown the most over the gilts as the barrows average weight was 172.85 (±3.53) lbs. and the gilts average weight was 167.72 (±2.88) lbs. shown below in (Table 6).

Table 6. Feed A Gender Comparison

Treatment	Sex	Weight LSMean	Standard Error	p<0.05
A	B	172.853	3.53	0.6755
A	G	167.725	2.88	

The opposite results occurred in Group B where the gilts weighed in an average weight of 164.44 (±3.53) lbs., and the barrows in the group only weighed in an average of 153.78 (±2.88) lbs., noted in (Table 7). Even with the weight difference between male and female pigs in both groups, there were no significant differences in either group.

Table 7. Feed B Gender Comparison

Treatment	Sex	Weight LSMean	Standard Error	p<0.05
B	B	153.78	2.88	0.0965
B	G	164.44	3.53	

In (Table 8), when barrows were compared between both groups, a significant difference between feeds was observed. The barrows on feed A averaged 172.85 (±3.53) lbs. compared to barrows raised on feed B who only averaged 153.784 (±2.88) lbs.

Table 8. Barrow Treatment Comparison

Treatment	Sex	Weight LSMean	Standard Error	p<0.05
A	B	172.853	3.53	0.0004
B	B	153.784	2.88	

The gilts average weight compared across feeds were much closer than the barrows, noted in (Table 9). Feed A's gilt average weight was 167.72 (±2.88) lbs. whereas the gilts from feed B only averaged 164.44 (±3.53) lbs.

Table 2. Gilt Treatment Comparison

Treatment	Sex	Weight LSMean	Standard Error	p<0.05
A	G	167.72	2.88	0.89
B	G	164.44	3.53	

The barrows from Feed B were the lowest performing in the trial as two of the three barrows in the group had two of the lowest total weights across the board and also had the two of the lowest individual ADGs. The barrows from Feed A were the highest performing pigs in the trial finishing the trial with the highest average weight and the highest feed conversion in the trial.

Carcass Performance

After the feeding trial was complete the pigs were sent to be processed at Texas A&M University Rosenthal Meat Laboratory in order to determine which feed not only performed well through feed efficiency, but also which feed produced the most valuable carcasses.

The first measurement taken was hot carcass weight in which the group from Feed A presented the largest carcass weight average 212.1(±11.62) lbs. Feed B possessed an average carcass weight of 191.2 (±11.62) lbs. as noted in (Table 10). There were no significant differences between genders within or across groups.

Table 10. Feed Comparison Carcass Data

Feed Comparison Carcass Data			
Data Collected On	Feed A	Feed B	$p<0.05$
Carcass Weight (lbs.)	212.10 (±11.62)	191.30 (±11.62)	0.25
Dressing Percentage (%)	79.37 (±0.44)	79.64 (±0.44)	0.68
Loin-Eye Are (sq. in.)	8.75 (±0.3)	8.63 (±0.3)	0.78
Percent Lean (%)	55.84 (±1.6)	56.38 (±1.6)	0.82
Tenth Rib Fat (in.)	0.70 (±0.4)	0.74 (±0.24)	>0.05

The data reported in (Table10) shows the groups averaged very closely on dressing percentage as both groups dressed out close to 79.5% with no significant difference. The barrows from group A dressed out nearly 2% lower than the gilts of the same group, while the barrows from Group B dressed out just over 0.5% higher than the gilts.

Last rib fat and tenth rib fat were very close among both groups and neither showed a significant difference between the two groups. Group A's last rib fat was 0.98 in. while Group B showed to be slightly leaner with only 0.87 in. Both groups averaged almost identical on tenth rib fat measuring at 0.72 in.

Loin eye area was recorded for both groups showing Group A possessing an average LEA of 8.75 sq. in. while Group B was slightly smaller with an average LEA of 8.63 sq. in. Although there was a difference in size, there was no significant difference between groups. The gilts from both groups combined averaged an LEA of 8.93 sq. in. while the barrows from both groups only averaged 8.45 sq. in. The gilts from group A averaged a LEA of 9.06 sq. in. outperforming all others in the trial.

Percent lean was the last measurement recorded in S.A.S. and again no significant difference occurred between groups although Group B possessed the slightly leaner carcass with 56.38% lean and Group A dressed out a 55.84% lean carcass.

Yield grades appeared to be about average compared to the industry but what became interesting was the two of the pigs in Group A received an unacceptable quality grade. The two who received this quality grade were a barrow and gilt; they were also two of the largest pigs in the trial and possessed two of the larger LEA's recorded.

DISCUSSION

Study I

Absorbezz®, containing a proprietary blend of complex ionic minerals, trace minerals, calcium carbonate, and mastic gum, was fed at the recommended dose of 0.32mL and added as a top-dressing on an industry standard sow diet. The diet was fed 3 lbs./head/day at the beginning of the trial, and throughout farrowing until they weaned their litters. The thought was that the combination of mastic gum, ionic minerals, and trace minerals would aid the gilts in the following parameters during the trial: conception, total born, total born alive, birth weight, weaning weight, and return to estrous.

Absorbezz® showed a negative effect on conception rates as six gilts from the treatment group would not cycle and only one gilt did not cycle from the control group. Significant differences appeared in the trial for total born and total born alive numbers as the control group showed to produce 11.1 (±0.92), an average of 4.1 more piglets per litter on total born parameters than the treatment group (Absorbezz®). When total born alive numbers were documented the control group produced 8.2 (±0.85) an average of 2.9 more piglets per litter than the treatment group. However, these numbers still fall below those of the U.S.

Pork Industry Productivity Summary, which cites averages of total born numbers are 13.5 (±1.0) and total born alive are 12.1 (±1.0) (Stalder, 2013).

Birth weights 3.99 (±0.19) lbs. and weaning weights 8.59 (±0.75) lbs. showed no significant difference among the control or treatment groups but still fell below the industry average weaning weight of 13.9 (±1.9) lbs. (Stalder, 2013). Even though the production numbers from this trial fall below the commercial industry average they are still justifiable within the show pig industry as it only takes one good pig sold to make up for several non-productive litters.

The return to estrous data showed a significant difference in favor of the treatment group (Absorbezz®) averaged just over a five day interval post-weaning returning to estrous in comparison of the control group whose interval was just over seven days post-weaning. The five barren sows that had failed to conceive a litter prior to the feeding trial and were placed into the Absorbezz® treatment group. Two of them conceived, carried to term, farrowed and each weaned litters of piglets.

In a study evaluating the effects of dietary sodium, potassium, and chloride in growing swine it was concluded that the deletion of added minerals showed a depression (<0.03) in the gain to feed ratio; however, the moderate levels of added dietary minerals provided the most gain and feed efficiency in the growing swine. Lastly, the concentrated dose of added minerals caused a depression in gain (<0.1) (Golz and Crenshaw, 1990). The added levels of chloride, magnesium, sodium, calcium, and potassium could explain the decreased performance in the treatment group of this trial.

Although this type of research has not been prevalent in the swine industry, poultry studies provide a valuable comparison. The findings from this feeding trial disputed the results of another trial conducted by Adelaja (2015), at the SFASU Poultry Center. The poultry trial collected data on 5,750 birds that were fed rations with different levels of Absorbezz®. The results from the data collected concluded that Absorbezz® had no adverse effect on the performance on the birds. However, the research noted the supplement could be used in replacing current growth promoting supplements. Adelaja (2015) found that Absorbezz® aided in adding weight to the broilers and increased carcass yield compared to the industry standard. The treatment with the highest concentration of 120% Absorbezz® showed was the most efficient in feed conversion and maintained the highest average body weight. It was concluded that feeding the concentration of 100% Absorbezz until day 42, and then increasing to 120% after day 42, would provide the maximum results for broilers (Adelaja, 2015).

Study II

The data from this trial show that the pigs from Feed A finished the trial with a FCR of 6.64 lbs. of feed/ lb. of gain, whereas the pigs from Feed B had an FCR of 7.54 lbs. feed/ lb. of gain. The feeds tested in this trial are sold as show feeds and in the show industry these feeds are hand fed once or twice daily and not *ad libitum.* Therefore, the results from this trial do not directly correlate with the average swine FCR (3:1) likely due to the fact that it was fed from a self-feeder instead of the way the way it was formulated to be utilized.

Lysine is added to many swine rations especially grain-based diets as it is the limiting amino acid in those diets (Cromwell et al., 2011). Soybean and soybean by products provided the largest quantity of lysine to the two rations utilized in the trial. Without added lysine, pigs cannot utilize the other essential amino acids for optimal performance (Cromwell et al., 2011). Several studies have been executed to determine proper levels of lysine in a diet, but not many have been performed to determine the most efficient level for show pig rations. The lysine level in Feed A was 1.05% in comparison to the 1.45% in Feed B.

Barrows have a higher average daily intake and gain body weight more rapidly than gilts, on the other hand gilts are more efficient in converting feed to weight gain and deposit a higher percentage of lean muscle and a lower percentage of fat tissue than barrows (Ekstrom, 1991).The carcass trends were reported from this feed trial directly correlate with other studies conducted comparing carcass qualities of barrows and gilts. In a study looking at interactions between genders and lysine levels it was reported barrows grew faster, consumed more feed, and produced carcasses with more fat and less muscle than gilts (<0.01). The study also reported even though the gilts grew slower than the barrows their F:G ratio were much more efficient, and on the rail the gilts produced a much leaner carcass as they converted the higher dietary protein into muscle instead of fat like the barrows from their study (Cromwell et al., 2011).

Latorre et al. (2011), noted that barrows had a greater average daily intake and average daily gain but a lower feed conversion than the gilts. Gilts also produced a leaner quality carcass with a larger loin eye area, which directly correlates to findings in the present research as the gilts from both treatments produced an average Loin eye area of 8.93 sq. in. while the barrows from both groups only averaged 8.45 sq. in. The gilts from the feeding trial were considerably leaner than the barrows from both feed groups.

CONCLUSIONS

Study I

The purpose of this trial was to evaluate the efficacy of Absorbezz® on the reproductive performance in gilts; collecting data on TB, TBA, BW, WW, and RE. Average numbers for TB and TBA within the treatment group did not correspond with the claims made by the Absorbezz® label nor did the mastic gum show any positive effect, as the treatment were significantly lower (<0.05) from the control group. There was no statistical difference between the control and treatment group for BW and WW. Return to estrous did however have a statistical difference in favor of the treatment group (5.1 ±0.27) days whereas the control group (7.6 ± 0.29) days (<0.001). More research is needed in order to confirm if the supplement and mastic gum do provide the assistance it claims. The sample size from this study was too small and resulted in a Type II error and statistically cannot claim that the supplement and mastic gum do not improve reproductive performance. However, the data collected and analyzed from this trial disagrees with the claims made by the product. Further research should include a larger sample size and focus on sows as it may provide more consistent results on conception rates and reproductive efficiency. Blood samples should also be taken to measure the levels of the supplement throughout the trial and see the effect on the piglets as well.

Study II

The feeding trial compared the performance of two quality show feeds available at two different costs to see which feed could be the best investment. The parameters measured in this trial were average daily gain and feed conversion for feed efficiency measures and for carcass data carcass weight, dressing percentage, loin eye area, and percent lean.

Feed A, the more costly feed, resulted with the more efficient FCR as it resulted in a pen average (6.64lbs. of feed/ 1lb. of gain) and feed B resulted in a pen average of (7.54lbs. of feed/ lb. of gain). Average total intake for Feed A was 281.72 lbs. and for Feed B it was 278.83lbs., breaking that down further both pens averaged a daily intake of 2.5lbs.

Hot carcass weight was recorded from the 10 pigs and Feed A presented the largest carcass weight average 212.1 (±11.62) lbs. and with no significant difference the group from Feed B possessed and average carcass weight of 191.2 (±11.62) lbs. Dressing percentage showed no statistical difference as both groups recorded an average of 79.5% lean. There were no significant differences between groups for loin eye area, 10^{th} rib fat, or yield grades of the carcasses.

Percent lean resulted differently than most of the parameters where Feed B actually produced the leaner carcass measuring at 56.38% where pigs from Feed A only produced a 55.84% lean carcass.

Feed A pigs finished the trial with the most weight, the fastest to weigh 250lb. and the most feed efficient, but if a larger sample size could be utilized there could be more significant difference among groups. More research should be performed to focus on more efficient ways to get pigs to market weight while providing a cost efficient feed as well. The research should separate genders from each other and experiment on rations that will be most efficient for the gender and their role in production.

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APPENDIX A

Feed A

- Crude Protein,…………………………...min18.0 %
- Lysine,…………………………………....min1.05 %
- Crude Fat,……………………………...min 6.0 %
- Crude Fiber,……………………………max4.0 %
- Calcium, ……………………………......min0.6 %
- Calcium,………………………………...max1.1 %
- Phosphorus,……………………………..min0.65 %
- Salt, ……………………………………..min0.1 %
- Salt, ……………………………………max0.6 %
- Zinc, ……………………………….....min800 ppm
- Selenium,…………………………….…min0.3 ppm

INGREDIENTS

Ground Corn, Dehulled Soybean Meal, Dried Whey, Soybean Hulls, Animal Fat, BHT (A Preservative), Feeding Oat Meal, Sodium Bentonite, Dicalcium Phosphate, Fish Meal, Calcium Carbonate, Lignin Sulfonate, Maltodextrin, Blood Meal, Salt, Wheat Dextrin, Maize Syrup Solids, Sucrose, Wheat Starch, Sodium Propionate (A Preservative), Zinc Methionine Complex, Extracted Citric Acid Presscake, Copper Sulfate, Choline Chloride, Ferrous Sulfate, Zinc Sulfate, Manganese Sulfate, Mineral Oil, Calcium Iodate, Yeast Culture (Saccharomyces cerevisiae), Diatomaceous Earth, Zinc Oxide, L-Lysine, DL-Methionine Hydroxy Analogue Calcium, Natural and Artificial Flavors, Biotin, dalpha Tocopheryl Acetate (Source of Vitamin E), Calcium Pantothenate, Niacin Supplement, Vitamin A Supplement, Menadione Dimethylpyrimidinol Bisulfite, Pyridoxine Hydrochloride, Riboflavin Supplement, Folic Acid, Vitamin B12 Supplement, Vitamin D3 Supplement, Selenium Yeast, Dried Schizosaccharomyces pombe Fermentation Product.

APPENDIX B

Feed B

Crude Protein, minimum 18.00%
Lysine, minimum 1.45%
Crude Fat, minimum 6.00%
Crude Fiber, maximum 4.00%
Calcium (Ca), minimum 0.60%
Calcium (Ca), maximum 1.10%
Phosphorus (P), minimum 0.50%
Salt (NaCl), minimum 0.25%
Salt (NaCl), maximum 0.75%
Selenium (Se), minimum .... 0.30 ppm
Zinc (Zn), minimum .... 225 ppm

INGREDIENTS
Ground corn, soybean meal, fish meal, rice bran, soybean oil, dried whey, calcium carbonate, dicalcium phosphate, salt, L-lysine, brewers dried yeast, yeast culture (*Saccharomyces cerevisiae*), hydrolyzed yeast, bentonite, hydrogenated vegetable fat, oregano oil, clove oil, cinnamon oil, red pepper extract, dried *Aspergillus oryzae* fermentation product, dried *Aspergillus niger fermentation* product, dried *Lactobacillus acidophilus* fermentation product, dried *Enterococcus faecium* fermentation product, dried *Lactobacillus plantarum* fermentation product, dried *Lactobacillus casei* fermentation product, fenugreek, rose hips, vitamin A supplement, vitamin D3 supplement, vitamin E supplement, vitamin B12 supplement, riboflavin supplement, niacin supplement, calcium pantothenate, choline chloride, menadione sodium bisulfite complex (source of vitamin K activity), folic acid, pyridoxine hydrochloride, thiamine mononitrate, sodium selenite, biotin, manganese sulfate, zinc sulfate, ferrous sulfate,copper sulfate, calcium iodate, artificial flavors.

VITA

After graduating from Redwater High School in 2010, Scott Sutton enrolled into Texarkana College for 2 years before transferring to Stephen F. Austin State University in Nacogdoches, Texas. There he received the degree of Bachelor of Science in Animal Science May 2015. While working at Lone Star Farm & Home Center he became a Graduate Assistant in the Dept. of Agriculture while enrolled in the Master of Science program. He received his Master of Science degree in Agriculture May 2017.

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