Toward a scientific understanding of DDGS

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1.1 INTRODUCTION

Recently, many people have asked what the fuel ethanol industry is going to do about the growing piles of nonfermented leftovers. Actually this question has been around for quite some time. As early as the 1940s, one report stated that “Grain distillers have developed equipment and an attractive market for their recovered grains” (Boruff, 1947), while another report described that “Distillers are recovering, drying, and marketing their destarched grain stillage as distillers dried grains and dried solubles” (Boruff, 1952). So it appears that a viable solution had already been developed as far back as the 1940s. And by the early 1950s, there was already a considerable body of published literature on both ethanol manufacturing as well as the use of distillers grains as animal feeds (see Chapter 3 for more information).

Over the course of the last century, some aspects of ethanol and distillers grain processing have changed, but others have not. For example, the production process that is currently used in modern fuel ethanol manufacturing plants remarkably resembles that of the 1940s (Figure 1.1); back then approximately 17 lb (7.7 kg) of distillers feed was produced for every 1 bu (56 lb; 25.4 kg) of grain that was processed into ethanol (which is very similar to today), but over 700 gal (2650 L) of water was required to produce this feed (Boruff et al., 1943; Boruff, 1947, 1952)—this was over two orders of magnitude higher than in modern plants!

1.2 GROWTH OF A MODERN INDUSTRY

Since Henry Ford’s time, there had been interest in using grain-based alcohol as a transportation fuel. Prohibition, however, severely constrained development in the United States. After Prohibition ended, both the beverage and fuel ethanol industries grew. But it was not until the price of petroleum escalated during the Oil Crises of the 1970s that the fuel ethanol industry truly began to grow in the United States. And grow it has. At the end of 2010, over 13.1 billion gal/y (49.7 billion L/y) of fuel ethanol were produced, and 204 fuel ethanol manufacturing plants were operating in the United States. These are primarily located in midwestern states (coinciding with the U.S. Corn Belt), because this is where the raw materials (mainly corn) are mostly grown. Due to the growth in demand for ethanol, new plants are now being constructed outside the corn-producing regions of the United States as well. By the time this book is published, the statistics will undoubtedly have changed. Updated information can be found at RFA (2010) and its website (www.ethanolrfa.org).
In recent years, as the price of gasoline has risen to near record levels again, there has been a contemporaneous surge in interest in renewable energy, particularly biofuels. This has been reflected in public discourse as well as scientific research on a variety of feedstocks (not just corn), in terms of production, logistics, processing, and conversion. The peer-reviewed literature is replete with new studies; books are also growing in number. Some of the most recent works include, but are not limited to, Cardona et al. (2009), Drapcho et al. (2008), Haas (2010), Ingledew et al. (2009), McNeil and Harvey (2008), Minteer (2006), Mousdale (2008), Mousdale (2010), and Olsson (2007).

While it can be debated whether ethanol production (and use) has a positive or negative energy balance, whether it leads to deforestation in the Amazon rain forest, and whether this approach to meeting fuel demand is sustainable in the long run, there is no question that millions of tons of nonfermented residues are currently available to the feed industry, primarily in the dry form of distillers dried grains with solubles (DDGS), and to a lesser extent in the wet form of distillers wet grains (DWG). During the past several years, ethanol coproducts have become major feed ingredients in North America, and DDGS has become a global agricultural commodity as well. Because the coproducts are now available in such great quantities, a tremendous amount of research has been conducted in recent years to determine their suitability in various livestock diets, as well as best practices for their use.

DDGS is a heterogeneous granular material, and it varies from plant to plant, as well as over time within any given plant. Thus DDGS can be challenging to use, both in terms of nutrient properties, but also physical characteristics. There is a growing body of literature (both scientific and anecdotal) attempting to determine optimal utilization for various animals. Most of this information has been in the form of conference papers, extension publications, magazine articles, as well as other forms of information available on the Internet. Many articles have been published for livestock producers—the end users of the coproducts. And each year, more peer-reviewed journal articles are published as well. To date, however, a comprehensive compilation and discussion of this information for the scientific and technical community has been lacking. This work aims to address that...
gap. The overall objective of this book is to provide a thorough summary of all aspects of DDGS, ranging from the corn kernel itself all the way through end use. The broad topic of distillers grains intersects a variety of disciplines, including physics, chemistry, microbiology, biology, animal science, as well as engineering and economics. This book will tie these diverse areas together.

1.3 CONCLUSIONS

As the industry continues to evolve, new manufacturing processes will undoubtedly change how ethanol is produced, and will also impact the resulting DDGS. Ethanol production cannot be successful without the sale of distillers grains. As the industry moves forward, it is important to have a solid reference base to serve as a strong technical guide on numerous aspects relating to distillers grains. And hopefully this book will serve useful in that regard.

REFERENCES