SUPPLEMENTAL FEED USAGE IN BEEF CATTLE OPERATIONS ACROSS THE SOUTHEASTERN UNITED STATES

by

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ABSTRACT

This study assessed the extent of use and nutritional value of essential byproduct feedstuffs in beef cattle production systems across the southeastern US. Byproducts like distillers grains, whole cottonseed, and corn-gluten feed are crucial for supporting cattle growth during times of limited forage availability. However, many novel feedstuffs are underrepresented in industry reference tables. Conducted from September 2023 to February 2024, this research used a regional survey of 142 participants to analyze feeding practices, alongside nutritive analysis of 35 submitted samples. The experiment assessed the nutritive value of whole samples and separated components, revealing significant trends in line with Nutrient Requirements of Beef Cattle (2016) reference values, though deviations in total digestible nutrients, ash, and acid detergent lignin were noted. Additionally, a systematic review of 17 publications confirmed byproduct supplementation generally improves average daily gain in cattle in forage-based beef systems.

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LIST OF ABBREVIATIONS AND SYMBOLS

The author has made all efforts to observe the accepted abbreviations for *Journal of Animal Science* and *Applied Animal Science* as these are potential outlets for publication. The following list provides the abbreviations accepted by these journals as well as additional acronyms or abbreviations used throughout this document:

Abbreviation	**Definition**
ADF	acid detergent fiber, expressed inclusive of residual ash and assayed sequentially to neutral detergent fiber unless otherwise noted
ADG	average daily gain
ADL	acid detergent lignin
ANOVA	analys(es) of variance
AOAC	Association of Official Analytical Chemists
B	boron
BW	body weight
°C	degree(s) Celsius
c-	centi- (1×10^{-2}; prefix for physical units)
CF	crude fiber
CP	crude protein, calculated as nitrogen times 6.25
d	day(s)
d-	deci- (1×10^{-1}; prefix for physical units)
df	degrees of freedom

DM	dry matter
doi	digital object identifier (used with citations)
F	*F*-distribution or ratio of variances (also identified as Snedecor's *F* statistic)
g	gram(s)
h	hour(s)
ha	hectare(s)
hd	head (count of animals)
k-	kilo- (1×10^3; prefix for physical units)
L	liter(s)
M-	mega- (1×10^6; prefix for physical units)
m	meter(s)
m-	milli- (1×10^{-3}; prefix for physical units)
min	minute(s)
mo	month(s)
n	sample size
NDF	neutral detergent fiber, assayed inclusive of α-amylase (unless otherwise stated), exclusive of sodium sulfite (unless otherwise stated), and expressed inclusive of residual ash
OM	organic matter
P	probability
PICO	population, intervention, comparison, and outcome
SAS	SAS Institute, Inc. (formerly known as Statistical Analysis System)

SEM	standard error of the mean
SR	systematic review
t	*t*-distribution or Student distribution
TDN	total digestible nutrients
US	United States
vs.	versus
W	Shapiro-Wilk's *W* (a measure of normality)
wk	week(s)
wt	weight
yr	year(s)
α	probability of Type I error
μ-	micro- (1×10^{-6}; prefix for physical units)

CHAPTER I

INTRODUCTION

Background of the Study

Supplementation of cattle on pasture is a strategy for optimization of grazing performance in beef cattle that is used by many farmers. Although cattle can be managed on forage alone, the needs of the animal for optimal performance are rarely met, especially in particular seasons of forage growth (Rouquette, 2000). A strategy that can be used to increase cattle performance while grazing forages is supplementation with various types of feedstuffs. In recent years, the use of byproduct supplementation has been on the rise because of the decrease in economic impacts and the increase is sustainability (Salami et al., 2019). Using byproduct feeds coming from other sectors of the agriculture industry decreases overall waste (Rotz et al. 2019) and contributes to making the beef cattle industry more environmentally focused. Throughout the United States (US), many different byproducts are used including cottonseed, cotton gin byproducts, distillers grains, soybean meal, and many more. The types of available products are dependent upon both region and season (Kunkle et al. 1995). Overall, the use of byproduct feeds in a grazing beef cattle system cannot only help producers meet cattle nutritional needs, but also help producers be more economical and sustainable at the same time.

Statement of the Problem

As shown in previous work, byproduct supplementation is a great resource to meet the needs of cattle in a grazing scenario (Loy, 2007). However, due to many factors, including variation both within and between production facilities, improvements in crops, and methods of storage, feedstuffs can widely vary in nutritive value. Another factor to consider is advancement across different industries playing a role in the periodic change of byproducts as well as the creation of new byproducts. This leaves a need for the periodic evaluation of the current feedstuffs on the market to determine quality, use and value potential.

Research Objectives

Thus, the objectives of this research were to:

1. Determine the extent of byproduct feedstuff use in beef cattle supplementation across the southeastern United States.
2. Determine the variability in nutritive values of byproduct feedstuffs in the southeastern United States.

Style and Form

This manuscript was prepared according to "Instructions to Authors (revised 2017)" from *Journal of Animal Science* (ASAS, 2017). All attempts were made to adhere to this style, except in cases where divergence was needed to adhere to the policies of the Auburn University or to increase clarity in the document.

CHAPTER II

SYSTEMATIC REVIEW OF LITERATURE

Introduction

Beef cattle production is centered around utilization of forages as a feed source. Forages change throughout the year depending on environmental factors such as season, temperature, drought, and soil nutrient levels (Lascano et al. 2000). With these changes in forages, changes in nutrient composition of the forage exist as well. Murillo et al (2016) posited that growing steers are particularly susceptible to nutrient deficiencies because they require high levels of protein and energy to support tissue growth. Due to this, supplementation is an integral part of grazing systems in beef cattle production. Integrating supplementation into beef cattle systems provides nutrients to meet production demands when forages do not provide enough nutrients (Kunkle et al. 2000). However, supplementation can be an economic constraint on beef production systems. An alternative to reduce the economic constraint on cattle producers is to use byproduct feedstuffs as a method of supplementation.

Byproduct feeds can be described as secondary products produced in addition to the principal product (AAFCO, 2016). These products come from various industries including food, fiber, beverage, and bioenergy processing and production. While these products are often regarded as wasteful in the context of human food, they are highly nutritious when utilized as cattle feed. This source of feed can be a choice that is sustainable, economical, and nutritional when fed as a supplement in grazing cattle systems.

Therefore, we used systematic review (SR) methodologies to explore the influence of byproduct supplementation on animal performance in grazing beef cattle. We hypothesized that byproduct supplements provide an economical and nutrient-dense solution when fed alongside forages to meet the nutritional requirements of cattle. The aim of this study was to evaluate the scientific evidence available in the literature using SR to identify the effect of byproduct supplementation on grazing beef cattle performance.

Materials and Methods

Research Question and Protocol

The systematic review followed the PRISMA guidelines (Page et al., 2021). The search strategy was defined by the terms population, intervention, comparison, and outcome (PICO) (Pati and Lorusso, 2018). In this study, comparison was not applicable.

The population being explored in this study was beef cattle of any breed, age, or sex. The intervention included different types of byproduct feeds. The outcomes that were of interest included overall cattle performance including rate of gain and feed efficiency (Figure II-1).

For inclusion in this SR, publications had to meet three criteria. First, studies needed to focus on beef cattle. Second, they must involve a trial where the diet consisted of grazing forage combined with a byproduct supplement. Lastly, the byproduct supplement used in the trial had to consist of a single product (i.e., not a blended feed). Date of publication was not a factor in publication inclusion.

Search Methods for the Identification of Publications

The systematic literature search was conducted from July to October 2024 in the electronic databases Agricola (Table II-1), CAB Abstracts (Table II-2) and Web of Science (Table II-3). Literature was restricted to only open-access publications. All references were exported to Endnote v. 21 (EndNote, Philadelphia, PA, USA) for organization.

Publication Selection Criteria and Relevance Screening

Exported publications were screened using three steps. The first step included reading the title and applying five questions (Table II-4). The next step assessed the titles, keywords, and abstracts based upon nine questions (Table II-5). The last stage of evaluation included answering two questions (Table II-6). Microsoft Excel (Microsoft, Redmond, WA, USA) software was used during the screening process. When the evaluator answered "no" to one or more questions, the citation was excluded from the review. Date of publication was not a factor in publication inclusion.

Methodological Assessment and Data Collection Process

The first author was responsible for the extraction of data from the selected publications. The relevance of each publication was confirmed by reading them in full. The publications were restricted to languages in which the evaluator was fluent (English). The data from each publication was extracted and organized by characteristics including population, intervention, measures, outcome data, journal name, author(s), and year of publication. The data extraction form was adapted from previous studies (Marcal-Pedroza et al., 2023).

Considerations for Data Collection and Manipulation

Data highlighting the results of interest (including mean, standard deviation, *P*-value, the number of cattle in each study, and the type of byproduct supplement being used) was extracted from each publication and compiled. For overall beef performance, response variables included average daily gain (ADG; kg/d), feed efficiency (kg of feed/kg of gain) and rate of supplementation (percent of body weight [BW]). Studies may reflect differences in supplementation rates. To standardize these, rates were divided into three distinct categories: low (0 - 0.25% BW/d), intermediate (0.26 - 0.65% BW/d), and high (> 0.66% BW/d).

Results and Discussion

Publication Selection

Through our database search, a total of 18,479 citations were initially identified. From the publications identified, 38 had relevant abstracts and 38 were selected for eligibility. Finally, after assessing methodological soundness and suitable data, 28 publications were fully read, and, from those, 17 articles were chosen to have their data extracted for a future meta-analysis. When assessing full publications, a total of 22 publications were excluded from the study due to various reasons. Five of the publications were excluded because the supplement did not consist of one product (i.e., mixed ration). One publication was excluded because it was not fully accessible. Three publications were excluded because they were not published in English. One publication was excluded because the topic of the publication did not align with the aspects of the search. The final

11 publications were excluded because the reported data in the publications were not suitable for future meta-analysis.

The main characteristics of the 17 selected papers included controlled feeding trials in which a specific amount of supplement was being provided to beef cattle in a grazing setting. The aspects being measured in these studies were overall performance of beef cattle through the measurement of ADG.

The publications selected used the feedstuffs dried corn distillers grains (n = 8), dried wheat distillers grains (n = 2), cottonseed meal (n = 3), whole cottonseed (n = 1), rice bran (n = 1), crambe meal (n = 1), and poultry litter (n = 1). Average daily gain was assessed in 2,796 cattle. These studies took place in various locations across North America (Figure II-2), South America (Figure II-3), and Africa (Figure II-4).

Byproduct Composition

Many different products were evaluated throughout this study and include a variety of protein, energy, and roughage supplements. Protein supplements can be characterized as products that have greater than 20% crude protein (CP; Harris et al., 1980). Energy supplements can be characterized as products that have less than 20% protein and less than 18% crude fiber (CF) or less than 35% cell wall (Harris et al., 1980). In this study, protein supplements would include cottonseed meal (Velmourougane, 2021), crambe meal (Yong-Gang et al., 1993), and poultry litter (Gebru et al., 2019). Energy supplements can be characterized as products such as rice bran. Products like whole cottonseed, dried corn distillers grains, and dried wheat distillers grains can be categorized as both energy and protein supplements due to their high nutritional content (Mullenix et al., 2023). Mean nutritive values reported in the publications can be found in Table II-7.

Effects of Byproduct Feedstuffs on Beef Cattle Performance

Feedstuffs across the evaluated literature were offered at levels of 0.1 – 1% BW/d on a kg basis. As discussed previously, the study divided supplementation rates into three categories of low, intermediate, and high when assessing data. The trends revealed that for all products, with the exception of whole cotton seed and crambe meal, when supplemental intake increased, average daily gain increased as well. This is to be expected as the animal would be consuming more protein and energy as there is an increase in the amount of supplements being fed. The exception of whole cottonseed can be attributed to nuances of ruminant metabolism. It is difficult for the ruminant to digest whole cottonseed entirely before it is passed through the digestive system due to the fat content (Zinn and Plascencia, 1993). This leads to the animal not being able to absorb all available nutrients (Zinn and Plascencia, 1993). Therefore, as the amount of whole cottonseed being supplemented increased in the diet, the amount of nutrients that had the opportunity to be absorbed decreased. In the case of crambe meal, the ADG increased initially, then decreased with a small addition of supplementation, and then increased once more with another addition of supplementation. This product was only observed once in the study; therefore, the data cannot effectively be compared with another study.

Conclusions

This systematic review was conducted to assess the use of byproduct supplementation on beef cattle production performance. The results showed various types of byproduct feedstuffs being used across the globe. The trend across all products was that as the amount of the product increased, the overall performance of growing cattle improved. A future meta-analysis using the data from this systematic review will be conducted to verify these differences.

Table II-1 Results of an online database (Agricola) search to identify supplemental feeding strategies for grazing beef cattle as part of a systematic review

Database: Agricola
Search date: September 19, 2024

Query	Boolean phrase	Results (n)
1	(supplement* OR feed* OR feedstuff*).ti. OR (supplement* OR feed* OR feedstuff*).ab.	419,478
2	(cattle* OR steer* OR heifer* OR bull* OR cow*).ti. OR (cattle* OR steer* OR heifer* OR bull* OR cow*).ab.	206,895
3	(graz* OR pasture*).ti. OR (graz* OR pasture*).ab.	66,702
4	1 AND 2 AND 3	4,750
5	(dairy* OR holstein* OR jersey*).ti. OR (dairy* OR holstein* OR jersey*).ab.	97,997
6	4 NOT 5	2,982
7	(feedlot*).ti. OR (feedlot*).ab.	5,933
8	6 NOT 7	2,647

Table II-2 Results of an online database (CAB Abstracts) search to identify supplemental feeding strategies for grazing beef cattle as part of a systematic review

Database: CAB Abstracts (1910 – present, CABI Digital Library)
Search date: September 19, 2024

Query	Boolean phrase	Results (n)
1	(supplement* OR feed* OR feedstuff*).ti. OR (supplement* OR feed* OR feedstuff*).ab. OR (supplement* OR feed* OR feedstuff*).kw.	1,087,356
2	(cattle* OR steer* OR heifer* OR bull* OR cow*).ti. OR (cattle* OR steer* OR heifer* OR bull* OR cow*).ab. OR (cattle* OR steer* OR heifer* OR bull* OR cow*).kw.	572,122
3	(graz* OR pasture*).ti. OR (graz* OR pasture*).ab. OR (graz* OR pasture*).kw.	171,537
4	1 AND 2 AND 3	18,483
5	(dairy* OR holstein* OR jersey*).ti. OR (dairy* OR holstein* OR jersey*).ab. OR (dairy* OR holstein* OR jersey*).kw.	272,618
6	4 NOT 5	11,330
7	(feedlot*).ti. OR (feedlot*).ab. OR (feedlot*).kw.	10,650
8	6 NOT 7	10,516

Table II-3 Results of an online database (Web of Science) search to identify supplemental feeding strategies for grazing beef cattle as part of a systematic review

Database: Web of Science

Search date: September 19, 2024

Query	Boolean phrase	Results (n)
1	TI= (supplement* OR feed* OR feedstuff*) OR AB= (supplement* OR feed* OR feedstuff*) OR AK= (supplement* OR feed* OR feedstuff*)	2,111,863
2	TI= (cattle* OR steer* OR heifer* OR bull* OR cow*) OR AB=(cattle* OR steer* OR heifer* OR bull* OR cow*) OR AK=(cattle* OR steer* OR heifer* OR bull* OR cow*)	569,183
3	TI= (graz* OR pasture*) OR AB= (graz* OR pasture*) OR AK= (graz* OR pasture*)	147,572
4	#1 AND #2 AND #3	9,626
5	TI= (dairy* OR holstein* OR jersey*) OR AB= (dairy* OR holstein* OR jersey*) OR AK= (dairy* OR holstein* OR jersey*)	191,243
6	#4 NOT #5	5,920
7	TI= (feedlot*) OR AB= (feedlot*) OR AK= (feedlot*)	9,879
8	#6 NOT #7	5,316

Table II-4 Questions used to identify possible citations of interest in screening of manuscript titles to identify supplemental feeding strategies for grazing beef cattle as part of a systematic review

1.Does this abstract investigate primary research?	**2.Does this abstract investigate supplementation in beef cattle?**	**3.Does this abstract deal with byproduct supplements?**	**4. Does this abstract investigate productivity in a grazing setting?**	**5.Does this abstract evaluate overall performance of beef cattle?**	**6.Does this abstract evaluate any nutritional requirements of beef cattle?**
Yes (include)	Yes (include)	Yes (include)	a) Yes (include)	Average daily gain (include)	Crude Protein (include)
Literature Review (exclude)	No (exclude)	b) No (exclude)	b) No (exclude)	b) growth rate (include)	b) Fiber (NDF, ADF, ADL, TDN) (include)
c) Other (exclude)				c) Feed efficiency (include)	Dry matter (include)
				Dry matter intake (include)	d) Energy (include)
				None of the above (exclude)	None of the above (exclude)

Table II-5 Questions used to identify citation of interest in screening manuscript title, abstract, and keywords to identify supplemental feeding strategies for grazing beef cattle as part of a systematic review

Question	Yes	No
1. Is this paper published in English?		
2. Is the full paper available?		
3. Does this study investigate the effect of beef animal performance based on byproduct supplementation?		
4. Does this study use all beef cattle?		
5. Does this study use grazing as the basis of the diet?		
6. Are sufficient raw or unadjusted data provided for assessment of beef cattle performance?		
7. Are the measure of dispersion for the raw or unadjusted mean data provided for assessment of beef cattle performance?		
8. Are correlations or regressions coefficients provided for assessment of beef cattle performance?		
9. If the paper was excluded, why?	(brief description)	

Table II-6 Questions used to identify citation of interest in screening manuscript relevancy to identify supplemental feeding strategies for grazing beef cattle as part of a systematic review

Question	**Yes**	**No**
1. Is this paper peer reviewed?		
2. Is this paper considered conference proceedings?		
3. If the paper was excluded, why?	(brief description)	

Table II-7 Nutritive value of byproduct feedstuffs in publications from a systematic review of supplemental feeding strategies for grazing beef cattle

		Nutritive value parameter[2], % DM								
Product	**n[1]**	**DM[2]**	**OM**	**CP**	**NDF**	**ADF**	**ADL**	**TDN**	**NFC**	**Sources**
Dried distillers grains	1990	91.7		31.3	37.2	15.1		96.8	5.9	(Stalker et al. 2012); (Williams et al. 2012); (Watson et al. 2015); (Murillo et al. 2016); (Adams et al. 2022); (Wallis et al. 2023); (Wheeler et al. 2023)
Cottonseed meal	505		91.5	44.4	21.9	16.2	6.5			(Judkins et al. 1987); (Pitts et al. 1992); (Vendramini et al. 2010);
Rice bran	0	89.7		14.1	27.3			69.3		(Negrini et al. 2018)
Poultry litter	48	90.8		17.8	55.9	32.9	7.2			(Gebru et al. 2019)
Crambe meal	12	92.2		14.0	39.1	6.7	3.1	81.3	49.2	(Souza et al. 2015)
Wheat dried distillers grains	168	87.5	95.5	37.9	44.7	16.9		76.1		(Kerchove et al. 2011); (Damiran et al. 2016); (Larder et al. 2018)
Whole cottonseed	73			12.5		3.0				(Poore et al. 2006)

[1]n = Sample Size (# of head)
[2]DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; TDN = total digestible nutrients; NFC = non-fibrous carbohydrates

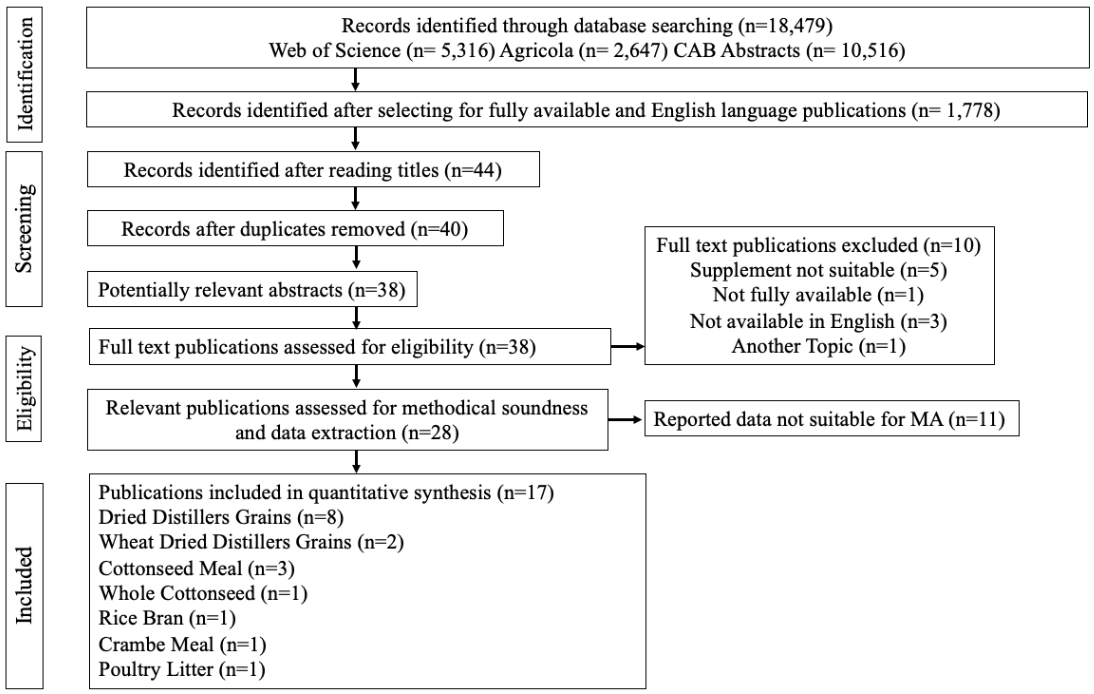

Figure II-1 Flow diagram indicating the number of citations and publications included and excluded in each level to identify supplemental feeding strategies for grazing beef cattle as part of a systematic review

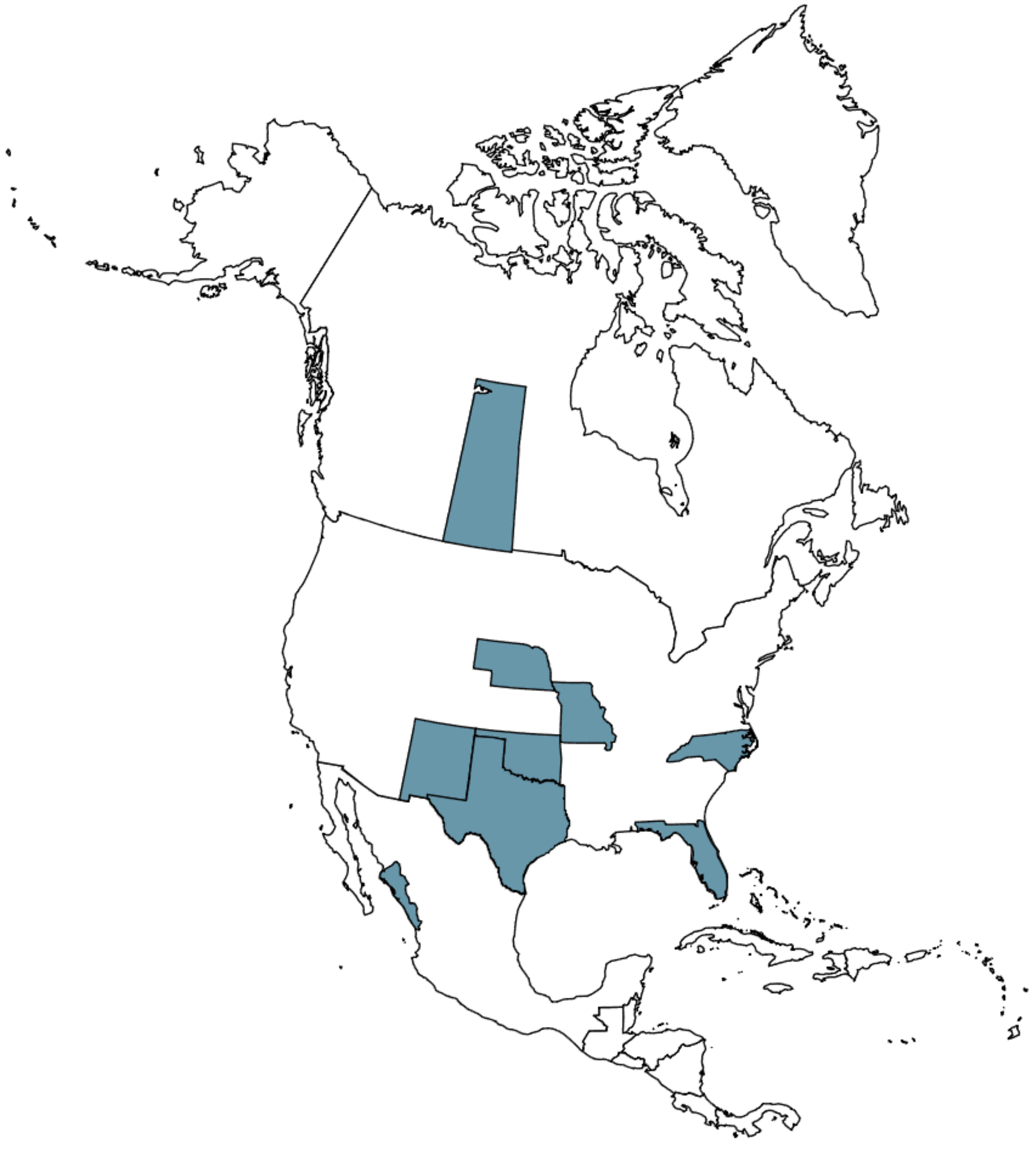

Figure II-2 A map of North America depicting areas (states/provinces) in which publications were included in the systematic review of supplemental feeding strategies for grazing beef cattle

Figure II-3 A map of South America indicating areas (countries) from which publications were included in the systematic review of supplemental feeding strategies for grazing beef cattle

Figure II-4 A map of Africa depicting areas (countries) from which publication were included in the systematic review of supplemental feeding strategies for grazing beef cattle

CHAPTER III

DETERMINING THE EXTENT OF USE AND NUTRITIVE VALUE OF BYPRODUCT FEEDSTUFFS IN BEEF CATTLE SUPPLEMENTATION ACROSS THE SOUTHEASTERN UNITED STATES

Synopsis

This study investigated supplemental feeding practices among beef cattle producers in the southeastern United States, aiming to understand the use and nutritive value of byproduct feedstuffs. Supplemental feeding is essential in this region to optimize forage utilization, correct nutrient deficiencies, and enhance cattle performance. The study distinguished between commodity feedstuffs, such as corn and oats, and byproduct feedstuffs, including whole cottonseed and distillers' grains. Byproducts, derived from other agricultural processes, offer cost-effective and sustainable feed supplementation options. The survey of 142 beef producers across several southeastern states gathered data on demographics, forage types, and supplementation practices. Sampling was conducted through online survey submissions from producers, followed by lab analyses of nutritional content that was submitted by producers. Participants' demographics revealed a predominantly male respondent base, with most managing cow-calf operations and a range of herd sizes. Grazing practices varied by forage type, with common perennial forages like tall fescue and bermudagrass, alongside annuals like ryegrass. The results show widespread supplementation, with byproducts used by nearly half of the survey participants. Byproduct usage patterns varied by regional availability and agricultural production trends, with cotton byproducts being more common in certain areas. In conclusion, this study provided insights into the current landscape of supplemental feeding and identified variability in nutritive value across byproducts. The results showed that most operations were incorporating supplementation into their operations in some form. The products being used did seem to be based upon location of operation and showed very similar results in extent of use of both commodity and byproduct supplementation products. These results set the groundwork for further exploration into sustainable feeding solutions for beef cattle operations in this region.

Introduction

Beef cattle production in the southeastern US is centered around grazing forages and using these strategies makes production much more efficient including supplementation (DelCurto et al., 2000). There are many different reasons that supplemental feeding of beef cattle consuming forage-based diets could be utilized. These could include correcting nutrient deficiencies, conserving forages, improving forage utilization, improving animal performance, increasing economic return, or managing cattle behavior (Kunkle et al., 2000). There are many different products that can be used to supplement beef cattle including both commodity feedstuffs and byproduct feedstuffs.

Commodity feedstuffs can be described as any product, raw or processed, that is derived from agricultural crops solely for the use of feeding food animals (Zeng et al., 2024). Examples of commodity feedstuffs include corn, oats, sorghum (milo), and wheat. A commodity feedstuff differs from a byproduct feedstuff in the sense that byproduct feeds can be described as products that are generated from the production of another product and would otherwise be waste if not used as animal feed (Fadel, 1999).

Byproduct feedstuffs are widely used across the southeastern US due to their economical and sustainable properties (Schnepf, 2011). Examples of byproduct feeds include whole cottonseed, distillers grains, brewers grains, corn gluten meal, and soybean hulls. With feeding being the highest input cost for raising beef cattle, finding an economic solution that can be widely applied is vital (Rusche, 2023). Products such as those previously mentioned can be valuable protein and energy sources in many different sectors of beef cattle production systems. These feedstuffs support the growth and maintenance of cattle in pastures where supplemental feeding is necessary to optimize forage utilization and support animal health and growth throughout different seasons (Mathis et al., 2012).

There is a gap in knowledge as to how producers are making use of supplemental feeding strategies as well as which feedstuffs are being used in operations. Additionally, when exploring the current landscape of various byproducts, it was discovered that both novel and locally available feedstuffs, which are commonly being used by producers, are not regularly updated in most reference tables being used by industry professionals. Thus, my objectives were to: a) describe the current landscape of byproduct feed ingredient availability and usage; and b) determine the variability in nutritive value among byproduct feedstuffs in the southeastern US, both as whole products and as separated components.

Materials and Methods

Survey Development and Distribution

An online survey was developed using Qualtrics^{XM} software (Qualtrics, Provo, UT, USA) to evaluate the use of byproduct supplementation in beef cattle operations in the southeastern United States (defined as Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Oklahoma, Tennessee, Texas and Virginia). This region was specified because the states listed make up the southern region for the USDA's Sustainable Agriculture Research and Education program (Southern SARE, 2023). The survey consisted of 24 questions (Appendix A) and was distributed in August of 2023. The survey was distributed through. The questions of the survey focused on several aspects of beef cattle operations in the southeastern US such as demographics of both producers and operations (i.e., type and size), types of forage being utilized, types of supplementation being utilized and, if applicable, what feedstuffs were being utilized. The total length of the survey was different for each participant based upon answers to specific questions.

The survey was distributed using state Extension personnel (County Extension Coordinators, Regional Extension Agents, and Extension Specialists), and collaborations with state commodity groups (state level Cattlemen's Associations). These agencies sent a direct link to the survey using producer email databases. The survey link was also shared on social media through the Alabama Cooperative Extension System (Alabama Beef Systems Extension Programs and Alabama Forage Focus Program Facebook Pages). A total of 142 responses were collected by February 2023, with 116 eligible participants.

Byproduct Sample Collection

Samples of byproducts were collected from September 2023 through February 2024 by the submission of producers in southeastern United States. Samples were packaged by producers in a small plastic bag and sent to the Auburn University along with a sample submission form (Appendix B). On arrival at the processing laboratory, samples were assessed for feedstuff type, date of collection, and purchase location. Samples were then dried in a gravity convection oven at 55°C for 72 h for determination of dry matter (DM) concentration. Dried samples were then divided into two aliquots. The first aliquot was sealed in a 0.51-kg Whirl-Pak bag (Whirl-Pak, Pleasant Prairie, WI, USA) and stored at room temperature (20°C) until further analysis. The second aliquot, with the exception of cotton byproducts, was ground using a Eberbach E3500 Series Mill (Eberbach Corporation, Van Buren Charter Township, MI, USA) to pass through a 2-mm screen, then re-ground to pass through a 1-mm screen. Cotton byproducts were processed in a KitchenAid Blade Coffee Grinder (KitchenAid, Benton Harbor, MI, USA) until the sample could be separated into a fine powder and fiber. The powder and fiber were then mixed and ground with the coffee grinder once more to make a homogenous mixture.

Whole samples were separated into components and particle size using two different methods based on type of sample provided. For pelleted samples, products were separated by hand by identifying the different types of pellets in one sample and grouping them together. For samples containing various particle sizes, products were separated according to the procedures of Lammers et al (1996) using a Penn State Particle Separator (Nasco Education, Fort Atkinson, WI, USA). Once separated, sample components were packaged separately into Whirl-Pak bags (Whirl-Pak, Pleasant Prairie, WI, USA). All separated samples were ground using an Eberbach E3500 Series Mill (Eberbach Corporation, Van Buren Charter Township, MI, USA) to pass through a 2-mm screen, then ground a second time to pass through a 1-mm screen.

Nutritive Value Assays

Dried and ground samples were assayed for nutritive value parameters. Organic matter (OM) was determined by combustion following the methods of the AOAC (2000). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were evaluated sequentially according to the methods of Vogel et al (1999) using an ANKOM^{2000} Fiber Analyzer (ANKOM technology, Macedon, NY, USA). Acid detergent lignin (ADL) was determined using the ADF residues according to the procedures of AOAC (2000). Crude protein was determined by combustion using an ECS 4010 (Costech Analytical Technologies, Valencia, CA, USA) to estimate nitrogen according to the procedures of AOAC (2000).

Statistical Analysis

Data were analyzed using SAS v. 9.4 (SAS Institute, Inc., Cary, NC, USA). Prior to analysis, raw data were organized using PROC SQL to report data in tables. All survey response variables were analyzed using PROC FREQ. Characteristics that were analyzed include participant age, participant sex, participant income status, operation types, herd size, forage type and use, supplementation type and use, and storage type. A χ^2 test of independence was used as a post-hoc analysis to identify specific associations between the categorical variables. The alpha level was established at 0.05, and differences were declared when $P < \alpha$.

Results and Discussion

The survey received a total of 142 responses. Of these responses, 116 were eligible inclusion in further analyses. State represented included Alabama, Arkansas, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia.

Demographics of Survey Participants

Personal demographics of survey respondents are presented in Table III-1. Of the total respondents (n = 98), 78.6% (n = 77) were male, while 21.4% (n = 21) were female (P < 0.01). This is to be expected as, male producers have higher rates of involvement in land use and/or livestock decisions than female producers (USDA NASS, 2023). The respondents ranged in age from 21 years old to 73 years old. Of the total respondents, 8.4% (n = 8) were from the generation "Generation Z" (12 - 27 years old), 34.7% (n = 33) were from the Millennial generation (28 - 43 years old), 21.1% (n = 20) were from the generation "Generation X" (44 - 59 years old), and 35.8% (n = 34) were from the "Baby Boomer" generation (60 + years old) (P < 0.01). The results shown here could be indicative of the age of landowners in the southeastern US, being 59 years of age (USDA NASS, 2023). The ages represented in the census showed very similar trends to those shown in the survey. In the US, 72% of farms are run by full owners, 22% are run by partial owners, and 6% are run by tenants renting farmland (USDA NASS, 2023). With that data, it is a possibility that the average age of farmers, and the percentage of farms owned by full owners, could have a correlation to why the average age of farmers is increasing in the southeastern US.

There was also diversity in terms of whether agricultural enterprises were their primary source of respondent income. A total of 56.6% (n = 56) of respondents stated that agricultural enterprises were not their primary source of income, while 43.4% (n = 43) stated that agricultural enterprises were the primary source of income (P < 0.01). This statistic could be representative of the number of smaller-sized farms located in the southeastern US (USDA NASS, 2023). The average net income at the farm level was $79,790 for both livestock and crops farming, with the value of crops sales exceeding those of livestock sales (USDA NASS, 2023). With the average beef cattle operation size in the southeastern US being 59 hd per farm, it can be presumed that the average income of beef cattle producers would be less than the total average income (McBride and Mathews, 2011; (USDA NASS, 2023). This could cause a constraint on producers as the average cost of operation for a cattle and calves operation in the Southern Seaboard (West Virginia, Virginia, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, and Texas) as of 2023 was $50,300, leaving only a small margin to use for living costs (USDA ERS, 2024). This constraint would cause producers to need another source of income in order to meet their economic needs for their living expenses.

Demographics of Farms Surveyed

Details on operational demographics from survey respondents are presented in Table III-2. When participants were asked to describe their operation the question included a multiple-select option. Results indicated 65.6% (n = 105) described their operations as cow-calf operations, 16.9% (n = 27) described their operations as seedstock operations and 17.5% (n = 28) described their operations as stocker operations ($P < 0.01$). Participants that selected either cow-calf or seedstock were asked how many breeding-age cattle they owned or managed. Results show 34.8% (n = 39) reported 1-25 head, 24.1% (n=27) reported 26-50 head, 32.1% (n = 36) reported 51-250 head, 8.0% (n = 9) reported 251-500 head, and 0.9% (n = 1) reported 501 or more head ($P < 0.01$). Further, participants who selected stocker operations were asked how many stocker cattle they owned or managed in their operation. Results show 32.1% (n = 9) reported 1-25 head, 10.7% (n = 3) reported 26-50 head, 46.4% (n = 13) reported 51-250 head, 7.1% (n = 2) reported 251-500 head, and 3.6% (1) reported 501 or more head ($P < 0.01$).

The results shown in this survey show similar trends to Asem-Hiablie et al (2018) and McBride and Mathews (2011), where data revealed that most operations in the southeastern US are cow-calf operations with stocker and seedstock operations having smaller numbers in comparison. The data also show similar trends in terms of the amount of cattle being owned or managed, McBride and Mathews (2011) reported that the average amount of cattle being managed on farms in the southeastern US is between 59 – 78 head, with the average number being 63 head. This is similar to my observations in terms of the amount of breeding age cattle being as 1-50 head and the amount of stocker cattle being reported as 51-250 head. Overall, the average herd size in the southeastern US is shown to be 59 head of cattle, which is similar to the results shown by the survey (USDA NASS, 2023).

Grazing Management Practices

Grazing management practices of survey respondents are presented in Table III-3. When participants were asked which perennial forages were being used in their operations; 32.7% (n = 69) reported the use of tall fescue *(Schedonorus arundinaceus* [Schreb.] Dumort., nom. cons.), 28.0% (n = 59) reported the use of bermudagrass (*Cynodon dactylon* [L.] Pers.), 19.0% (n = 40) reported the use of bahiagrass (*Paspalum notatum* L.), 12.8% (n = 27) reported the use of native warm-season grasses (indiangrass [*Sorghastrum nutans*

{L.} Nash], bluestem [*Andropogon* L.], switchgrass [*Panicum virgatum* L.]), and 7.6% (n = 16) reported the use of other perennial forages not indicated by the survey choices ($P < 0.01$). These data are typical of what perennial forages would be expected for this region of the US. Bermudagrass and bahiagrass are the two most commonly grown warm-season forages in the southern US when being used for yearly grass production (Redfearn and Nelson, 2018). As most of the respondents were located in the state of Alabama, this is consistent with what is being shown as a result of the survey. Especially in the upper parts of the southeastern US, tall fescue is the most widely grown pasture forage (Sheaffer et al., 2009). This statement aligns with what the survey results as the highest number of participants indicated that tall fescue was a perennial forage being used in their operations.

Participants were then asked if annual forages were being used in their operations and, if so, what species were being utilized. Results show 72.3% (n = 81) indicated that they were using annual forages in their operations while 27.7% (n = 31) indicated that they were not using annual forages ($P < 0.01$). From those who were using annual forages, 29.9% (n = 63) indicated the use of annual ryegrass (*Lolium multiforum* Lam.), 18.5% (n = 39) indicated the use of small grains (*Hordeum vulgare* L., *Avena sativa* L., *Secale cereale* L., *Triticosecale rimpaui* C. Yen and J.L. Yang [*Secale cereale* × *Triticum aestivum*], *Triticum aestivum* L.), 14.7% (n = 31) indicated the use of annual clovers (*Trifolium* sp.), 14.2% (n = 30) indicated the use of crabgrass (*Digitaria sanguinalis* [L.] Scop.), 9.5% (n = 20) indicated the use of pearl millet (*Pennisetum glaucum* [L.] R. Br.), 7.1% (n = 15) indicated the use of sorghum (*Sorghum bicolor* [L.] Moench) or sorghum-sudangrass (*Sorghum* × *Drummondii*), 4.7% (n = 10) indicated the use of brassicas (*Brassica oleracea* L.), 1.4% (n = 3) indicated the use of other annual forages ($P < 0.01$).

Findings from the survey are very similar to those of Macoon et al. (2016), as the most commonly identified forages including annual ryegrass, rye, wheat, oats, clovers, hairy vetch (*Vicia villosa* Roth), and some brassicas were also shown to be the most typically grown cover crops (Macoon et al., 2016).

Feeding and Supplementation Practices

Feeding management practices of survey respondents are presented in Table III-4. Participants were asked if they used any type of supplementation other than hay or haylage. The results show that 87.6% (n = 99) of participants used supplementation, and 12.4% (n = 14) did not use any supplementation in their operations ($P < 0.01$). If participants indicated that they used supplementation, they were then asked if they used commodity feedstuffs or byproduct feedstuffs. Results indicated that 50.4% (n = 68) of respondents use byproduct feedstuffs as supplement while 49.6% (n = 67) of respondents use commodity feedstuffs ($P = 0.93$). If participants indicated that they used commodity feedstuffs, they were then asked to specify which commodity feedstuff they were using. Participants indicated that 61.4% (n = 54) used corn, 14.8% (n = 13) used oats, 11.4% (n = 10) used wheat, 4.6% (n = 4) used sorghum (milo), and 8.0% (n = 7) indicated that they used other commodity feedstuffs ($P < 0.01$). If participants indicated that they used byproduct feedstuffs, they were then asked to specify which byproduct feedstuff they were using. Respondents indicated that 17.1% (n = 32) used whole cottonseed, 16.6% (n = 31) used corn gluten feed, 14.4% (n = 27) used soybean hulls, 10.7% (n = 20) used dried distillers grains, 9.6% (n = 18) used cottonseed meal, 9.6% (n = 18) used cotton gin byproduct, 6.4% (n = 12) used peanut hulls, 5.4% (n = 10) used soybean meal, 2.7% (n =

5) used dried brewers grains, 2.7% (n = 5) wet brewers grains, 1.1% (n = 2) used peanut skins, and 3.7% (n = 7) used other byproduct feedstuffs ($P < 0.01$).

Both commodity and byproduct feedstuffs can be variable in availability and usage depending on location of the operation. Variability is especially prominent with byproducts because the availability of byproduct feedstuffs is dependent upon what products are being made in the specific area (Poore, 2022). For example, cotton byproducts are not commonly going to be found in the northern parts of the US as there is little cotton production occurring in that region (National Cotton Council of America, 2022). Due to this, both the commodity and byproduct feedstuffs shown in the survey were expected, but also provided a greater perspective on what is currently available and being utilized.

Respondents were asked how they offered supplements to their animals. Of the respondents, 38.0% (n = 35) used pre-packaged commercial blends, 34.8% (n = 32) used custom blends, and 27.2% (n = 25) used feedstuffs individually ($P = 0.42$). The final question regarding feedstuffs was an inquiry about how participants stored their feedstuffs. Results indicated 42.2% (n = 38) of respondents indicated they used bins, 22.2% (n = 20) used commodity bays, 13.3% (n = 12) used multi-ton tote sacks and 22.2% (n = 20) used methods that were not indicated by the survey choices ($P < 0.01$).

These data are indicative of the types of feed and storage choices that are feasible in the southeastern US due to the typical weather, environmental conditions, and scale of operation. As stated by Parish et al (2018), the humid, warm climates are not conducive to long-term storage of feeds that rapidly mold or spoil. This statement can not only apply to specific feed choices but to feed storage options, as well. Dry feed choices, such as soybean hulls, wheat middlings, and whole cottonseed, can be a great option for humid climates due to their long storage periods (Poore et al., 2002). Wet products, on the other hand, such as wet distillers' grains can be much harder for producers to utilize because of their short storage periods due to rapid spoilage (Poore et al., 2002; Poore, 2022).

Feed storage options will vary depending on what type of feedstuff is being used. To lengthen the use of wet feedstuffs, storage options may include tightly sealing the product using airtight bags or covered bunkers (Poore et al., 2002; Klopfenstein et al., 2007). Dry feeds have many more storage options including grain bins, open bays, and covered piles and offer much more flexibility to small operations (Poore et al., 2002; Klopfenstein et al., 2007).

Byproduct Feedstuffs

A total of 35 samples were collected as a result of submission by producers in southeastern US. Of the samples collected, 13 were identifiable and were described as products made up of whole cottonseed, cotton gin byproduct, corn gluten meal, soybean hulls, dried distillers grains, oat middlings, poultry litter, and protein supplement mixtures. These samples were expected of this region and are discussed by Poore (2022). Common byproducts found in the South include corn gluten feed, wheat middlings, distillers grains, brewers grains, cottonseed, and cotton gin byproducts (Poore, 2022). These trends align the sample submissions.

The samples of whole cottonseed (n = 4) show very similar trends in terms of nutritive values as reported in the Nutrient Requirements of Beef Cattle (NRC; NASEM, 2016; Table III-5). The NRC reports DM of 92.6 ± 2.10% (mean ± standard deviation), NDF of 47.8 ± 6.96%, ADF of 42.9 ± 5.80%, and CP of 22.9 ± 2.53%, all which were very similar to what was shown using the submitted samples (n = 4). Differences can be found when looking at values of TDN (93%) and ash (4.1 ±0.36%). The sample did not have any values listed in the reference for ADL values.

Cotton gin byproduct (n = 3) was also similar to that reported in the NRC. The results showed DM at 90.7 ± 3.96%, ash at 12.1 ± 6.92%, NDF at 60.6 ± 12.57%, at 52.3 ± 12.63%, TDN at 48.5 ± 7.32%, and CP at 12.3 ± 4.09%. All of these values were similar to those seen in this study. All values fall within the ranges listed, with the exception of DM and ADL which were both < 1% different.

The samples of dried distillers grains (n = 1) are similar to the samples in the NRC in the categories of ADF, CP, and ash. The results showed ADF at 14.8 ± 3.06%, CP at 29.1 ± 2.45%, and ash at 6.7 ± 0.72%. The other categories of nutritive analysis, DM, NDF, and TDN showed trends that were not similar between the samples received in this study. The sample did not have any values listed in the reference for ADL values.

The samples of soybean hulls (n = 3) show very similar trends to the NRC in the values of NDF, ADF, and CP. The results show NDF at 64.8 ± 5.68%, ADF at 46.4± 4.84%, and CP at 12.4 ± 2.15%. All other values including DM, ash, ADL, and TDN are represented much higher in the study than in the NRC (Table VIII).

All other feedstuffs represented in the study including mixtures, and novel byproducts not represented in the NRC.

The differences between the values of the NRC and the values in the study for various aspects of nutrient composition could be due to several factors including evolution, location, processing, and storage. When speaking about evolution in byproduct feedstuffs, there are improvements being made in the breeding of crops, and new strategies in the industrial processing being used that may change what products are being produced at the end of processing. Location plays a factor into nutritive composition because the products that go into the processing of products, to ultimately produce byproduct feedstuffs, are determined on location of said crop. Processing plays a role in nutritive composition because different production plants may have different methods of making products (Mathis et al., 2007). Therefore, different methods may alter the overall composition of certain products. Storage also plays a role in nutritive composition due to many factors dealing with the weather and environment. In high heat, nutrients could degrade and lose moisture, and if stored improperly supplements may lose quality overall or spoil due to environmental factors such as bacteria and mold (Parish et al., 2024).

Separation resulted in many of the same products as those already addressed including corn gluten meal, cotton gin byproduct, whole, ground cottonseed, dried distillers grains, and soybean hulls. While the values were not identical to the whole products, the trends were very similar (Table III-6).

The samples consisting of soybeans (whole) ($n = 1$) were not comparable to those listed in the NRC in any category of nutritive composition except DM. Dry matter in the NRC was listed as 92.9 ± 2.93% which was very similar to the value found in the study. All other values including ash, NDF, ADF, ADL, TDN, and CP showed much lower values found in the study than in the NRC.

All other feedstuffs represented in the study including mixtures, and novel byproducts were not represented in the NRC.

Conclusion

The findings of this study provide valuable insights into the demographics, operational characteristics, grazing practices, supplemental practices, and nutritional characteristics being used in the beef cattle industry across the southeastern US. This information is essential for Extension personnel, professors, researchers, and producers alike to better understand the current trends in the region. The data on gender, age and income source may highlight the demographic profile of cattle producers to better adapt like Extension publications, Extension events and outreach efforts. The operational and grazing management data can provide information on current demographics and characteristics that should be currently focused on in Extension, teaching and research realms.Additionally, the results related to feeding and supplementation practices provide information on the different types of feedstuffs commonly used and available within a specific region of the US. This is extremely important as the data that was available on this topic was not up to date and is an ever-changing topic. Furthermore, information provided by the nutritive analysis will help improve recommendations on supplementation methods based upon products that are current and relevant in the industry at this time. This information can help improve beef cattle production in multiple ways including efficiency, economics, and sustainability.

Overall, as shown by the results most producers in the southeastern US are using supplementation in some form. These products included very similar results in both byproduct and commodity supplements being used. The product results showed that supplements were being used based on location. Having this up-to-date information can allow nutritionists, researchers, and producers to make informed decisions moving forward about the resources that are currently available.

Table III-1 Personal demographics from a survey used to determine the extent of use of byproduct feedstuffs in beef cattle supplementation across the southeastern United States

Category	**Value**	**n**	**%**	χ^2	***P*-value**
Generation				92.4	< 0.01
	Baby boomer	82	58.6		
	Gen X	20	14.3		
	Millennial	31	22.1		
	Gen Z	7	5.0		
Sex				32.0	< 0.01
	Male	77	78.6		
	Female	21	21.4		
Source of income				1.7	0.19
	Agricultural enterprises	43	43.4		
	Other	56	56.6		

Table III-2 Operational demographics from a survey used to determine the extent of use of byproduct feedstuffs in beef cattle supplementation across the southeastern United States

Category	**Value**	**n**	**%**	χ^2	***P*-value**
Operation type				75.1	< 0.01
	Seedstock	27	16.9		
	Cow-calf	105	65.6		
	Stocker	28	17.5		
Breeding herd size				50.0	< 0.01
	1 – 25	39	34.8		
	26 – 50	27	24.1		
	51 – 250	36	32.1		
	251 – 500	9	8.0		
	501+	1	0.9		
Stocker herd size				19.1	< 0.01
	1 – 25	9	32.1		
	26 – 50	3	10.7		
	51 – 250	13	46.4		
	251 – 500	2	7.1		
	501+	1	3.6		

Table III-3 Reported grazing management from a survey used to determine the extent of use of byproduct feedstuffs in beef cattle supplementation across the southeastern United States

Category	**Value**	**n**	**%**	**χ^2**	***P*-value**
Type of perennial forages				45.6	< 0.01
	Bahiagrass	40	19.0		
	Bermudagrass	59	28.0		
	Tall fescue	69	32.7		
	Native warm-season grasses	27	12.8		
	Other	16	7.6		
Do you use annual forages?				22.3	< 0.01
	Yes	81	72.3		
	No	31	27.7		
Type of annual forages				95.5	< 0.01
	Annual clovers	31	14.7		
	Annual ryegrass	63	30.0		
	Brassicas	10	4.7		
	Crabgrass	30	14.2		
	Millet	20	9.5		
	Small grains	39	18.5		
	Sorghum/sorghum-sudangrass	15	7.1		
	Other	3	1.4		

Table III-4 Reported feeding practices from a survey used to determine the extent of use of byproduct feedstuffs in beef cattle supplementation across the southeastern United States

Category	**Value**	**n**	**%**	**χ^2**	***P*-value**
Do you use supplemental feed?				63.9	< 0.01
	Yes	99	87.6		
	No	14	12.4		
What type of feedstuffs do you use in supplementation?				< 0.01	0.93
	Commodity feedstuffs	67	49.6		
	Byproduct feedstuffs	68	50.4		
In what form do you offer supplemental feed?				1.7	0.42
	Commercial blends	35	38.0		
	Custom blends	32	34.8		
	Individually	25	27.2		
How do you store your feed?				16.1	< 0.01
	Bins	38	42.2		
	Commodity bags	20	22.2		
	Multi-ton tote sacks	12	13.3		
	Other	20	22.2		
Type of commodity feedstuffs				96.6	< 0.01
	Corn	54	61.4		
	Oat	13	14.8		
	Sorghum (milo)	4	4.6		
	Wheat	10	11.4		
	Other	7	8.0		
Types of byproduct feedstuffs				79.7	< 0.01
	Corn gluten feed	31	16.6		
	Cottonseed (whole)	32	17.1		
	Cottonseed meal	18	9.6		
	Dried brewers grains	5	2.7		
	Dried distillers grains	20	10.7		
	Gin byproduct	18	9.6		
	Peanut hulls	12	6.4		
	Peanut skins	2	1.1		
	Soybean hulls	27	14.4		
	Soybean meal	10	5.4		
	Wet brewers grains	5	2.7		
	Other	7	3.7		

Table III-5 Nutritive value of feeds submitted for evaluation as part of the regional survey of beef cattle supplementation practices

		Nutritive value[2]						
Product	**n[1]**	**DM**	**Ash**	**NDF**	**ADF**	**ADL**	**TDN**	**CP**
Cottonseed (whole), corn gluten feed, and soybean byproduct	1	95.2	10.3	53.4	26.2	8.6	62.7	13.0
Corn gluten feed and soybean hulls	5	95.9 ± 0.11	10.3 ± 0.23	48.7 ± 2.97	28.4 ± 4.05	2.6 ± 0.57	61.1 ± 3.05	14.6 ± 0.83
Cotton gin byproduct	3	95.5 ± 1.18	13.5 ± 2.80	68.7 ± 7.36	54.4 ± 8.15	22.1 ± 2.27	41.5 ± 6.08	12.0 ± 3.25
Cottonseed (whole)	4	96.0 ± 1.08	8.9 ± 1.25	57.1 ± 1.70	41.2 ± 1.53	15.1 ± 3.93	51.4 ± 1.14	21.9 ± 8.04
Dried distillers grains	1	96.0	7.6	50.7	17.7	5.2	69.1	29.1
Oat middlings	1	94.5	8.5	34.8	14.9	2.7	71.2	11.5
Oat middlings plus sugar	1	94.7	34.9	28.4	11.8	2.1	73.5	10.6

[1]n = Sample size (# of head)

[2]DM = dry matter; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; TDN = total digestible nutrients; CP = crude protein;

Table III-6 Nutritive value of separated byproducts from feeds submitted for evaluation as part of the regional survey of beef cattle supplementation practices

		Nutritive value[2]						
Product	**n[1]**	**DM**	**Ash**	**NDF**	**ADF**	**ADL**	**TDN**	**CP**
Corn gluten feed	5	94.6 ± 1.32	12.7 ± 0.44	15.0 ± 1.79	4.7 ± 1.05	0.8 ± 0.48	78.9 ± 0.76	18.7 ± 4.04
Corn silage	1	92.7	11.3	25.3	16.9	6.1	69.7	11.7
Cotton gin byproduct (fine particles)	1	92.7	21.8	18.9	14.7	9.8	71.4	15.6
Cottonseed (finely ground)	1	94.1	13.2	17.3	10.2	4.4	74.7	31.1
Dried distillers grains and corn (whole)	1	93.9	8.7	11.1	3.2	0.6	80.0	11.7
Dried distillers grains and soybean hulls	2	94.1 ± 0.57	10.1 ± 0.64	21.3 ± 4.74	11.0 ± 1.91	1.3 ± 0.42	74.2 ± 1.48	18.5 ± 3.89
Oat middlings	1	93.9	9.1	14.3	6.6	1.1	77.5	11.8

[1]n = Sample size (# of head)

[2]DM = dry matter; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; TDN = total digestible nutrients; CP = crude protein;

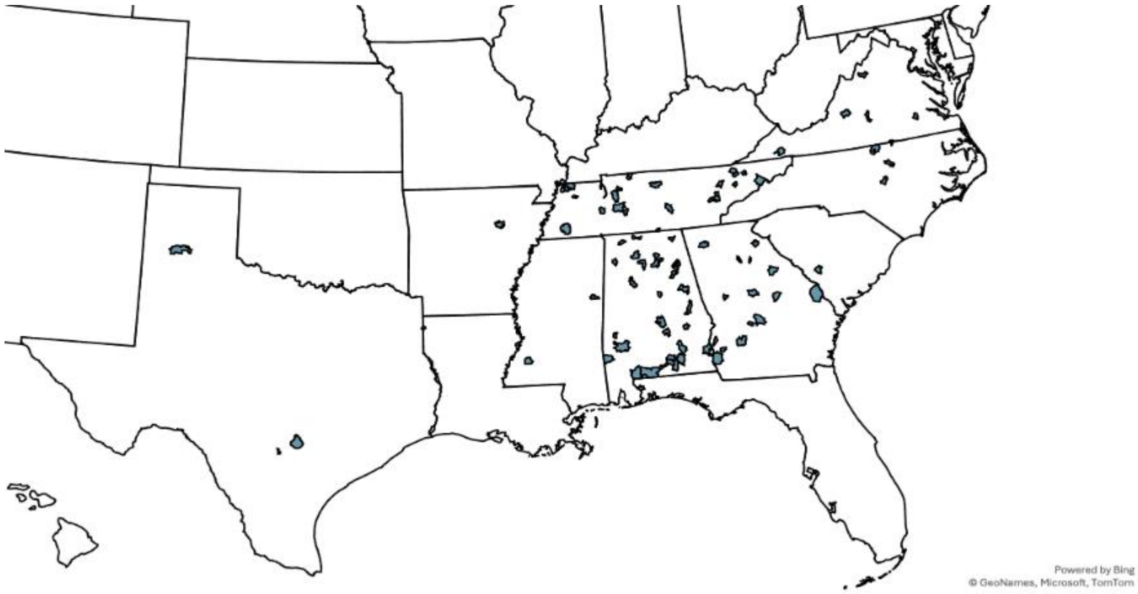

Figure III-1 A map depicting locations from which responses were received as part of the regional survey of beef cattle supplementation practices

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APPENDIX A

SURVEY TEXT

1. Do you own or manage beef cattle?
    a. Yes
    b. No

2. Do you reside in the southeastern United States (defined as Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia)?
    a. Yes
    b. No

3. What is your ZIP code?

4. Which of these describes your operation? If you are engaged in multiple segments, select all that apply.
    a. Seedstock
    b. Cow-calf
    c. Stocker

5. How many breeding age cattle do you own or manage?
    a. 1-25
    b. 26-50
    c. 51-250
    d. 250-500
    e. 501+

6. How many stock cattle do you own or manage?
    a. 1-25
    b. 26-50
    c. 51-250
    d. 251-500
    e. 501+

7. Which perennial forage species do you currently use in your operation? Select all that apply.
    a. Bahiagrass
    b. Bermudagrass
    c. Native Warm-Season Grasses (Indiangrass, bluestem, switchgrass)
    d. Tall Fescue

8. Do you use annual forage species (either alone or interseeded into perennial pastures)?
    a. Yes
    b. No

9. Which annual forages species do you currently use in your operation? Select all that apply.
    a. Annual Ryegrass
    b. Brassicas (Mustard, Canola/Rape, Swede, Turnip)
    c. Annual Clovers
    d. Crabgrass
    e. Small Grains (Barely, Oat, Rye, Triticale, Wheat)
    f. Millet
    g. Sorghum or sorghum-sudangrass
    h. Other

10. Other than hay/haylage, do you provide supplemental feed for pastured cattle at any point in the year?
    a. Yes
    b. No

11. Do you typically use commodity feedstuffs or byproduct feedstuffs? For purposes of this survey, we are defining commodity feeds as whole or processed grains grown specifically for livestock feed (e.g., corn, wheat, sorghum). We are defining byproduct feeds as any feedstuff that is produced in the processing of a primary plant, animal, or industrial product (e.g., cottonseed, peanut hulls, distillers, grains).
    a. Commodity Feedstuffs
    b. Byproduct Feedstuffs

12. Which commodity feedstuff(s) do you offer? Select all that apply.
    a. Corn
    b. Oat
    c. Sorghum (milo)
    d. Wheat
    e. Other

13. Which byproduct feedstuff(s) do you offer? Select all that apply.
    a. Corn Gluten Feed
    b. Cottonseed (whole)
    c. Cottonseed Meal
    d. Dried Brewers Grains
    e. Dried Distillers Grains
    f. Gin Byproduct
    g. Peanut Hulls
    h. Peanut Skins
    i. Soybean Meal
    j. Soybean Hulls
    k. Wet Brewers Grains

14. How do you source your byproduct feeds?
    a. Purchase feeds frequently due to limited storage
    b. Purchase in bulk from a feed supply vendor
    c. Purchase feed through a feed broker
    d. Other

15. Do you typically offer your feedstuffs individually, in commercial blends, or in custom blends?
    a. Individually
    b. Commercial Blends (e.g. pre-packaged feeds)
    c. Custom Blends

16. How do you store your feedstuffs?
    a. Bins
    b. Commodity Bays
    c. Multi-ton tote sacks
    d. Other

17. Why do you choose not to feed or supplement?

18. In addition to understanding the availability and extent of use of byproduct feedstuffs in the Southeast, we would also like to compile a set of laboratory testing of the products to inform feeding recommendations. Sample submission is completely voluntary, and the feed analysis will be complimentary to the producer.

19. Would you be interested in submitting a sample of your feed(s) for analysis?
    a. Yes
    b. No

20. Please enter your email address so that we may send you the materials necessary for sample submission. Those submitting samples will also be entered into a drawing for a CattleVac vaccine cooler. Your email will be used only for contacting you regarding sample submission and for the drawing; it will not be tied to your survey responses.

21. What is your year of birth?

22. What is your sex?
    a. Male
    b. Female
    c. Prefer not to answer

23. Are you primarily employed in an agricultural enterprise?
    a. Yes, my primary source of income is from agricultural enterprises.
    b. No, my primary source of income is not from agricultural enterprises.

24. If you wish to be entered into a drawing for a Yeti cooler as incentive for your participation, please provide your email address. This email will be used for the drawing only and will not be tied to your responses.

APPENDIX B

SAMPLE SUBMISSION FORM

Byproduct Feedstuff Sample Submission Form

"Extent of Use of Byproduct Feeds in Southeastern US"

Thank you for agreeing to submit a sample of your byproduct feedstuff for testing. The objective of this project is to better understand the current landscape of byproduct feed ingredient availability, usage, and potential for nutrient transfer (i.e., digestibility). Your sample will be analyzed free of charge by the Ruminant Nutrition Laboratory at Auburn University, and the results will be reported to you within 4 weeks (excluding any Auburn University holidays). You will receive information on organic matter, fiber, protein, and a calculated TDN value. You will also be entered into a drawing for a CattleVac Vaccine Cooler as incentive for your participation.

Sampling Instructions

The results that you receive from a laboratory analysis are only as good as the sample submitted. The greatest potential for error or variability is in the sampling process.

- The sample should be representative of the entire material being sampled.
- Multiple subsamples from different locations within the pile/stack are necessary to achieve a consistent sample for submission.
- Collect small subsamples in a clean bucket.
- Thoroughly mix the large composite samples, then collect a small (approximately ½ lb) sample in a Ziploc bag for submission to testing.

<u>Contact Information</u>

Name ________________________ Farm Name ________________________

Street/PO Box ____

City _____________________ State _____________ ZIP ____________________

Phone ________________________________ Email ________________________________

<u>Sample Information</u>

Sample Description ____

Sampling Date _________________ Length of Storage ______________________________

Source/Purchase Location ____