Raised Without Antibiotics: Analyzing the Impact to Biologic and Economic Performance

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1. Introduction

Alexander Fleming, a Scottish scientist, discovered our first antibiotic, penicillin. Since this discovery, antibiotics have served as a cornerstone of human and animal medicine, preventing pain, suffering and death in billions of patients throughout the world. Modern animal agriculture has been built around the readily available use of antibiotics, reducing mortality while improving animal well-being, caloric conversion and growth.

All antibiotic use contributes to antibiotic resistance and the general public has become increasingly concerned about potential areas of antibiotic "over-use". Animal agriculture is increasingly implicated with causing proliferation of antibiotic resistant pathogens threatening human health. While the scientific community lacks consensus on how to stack rank risk factors for antibiotic resistance development, our reality is, animal agriculture is being told to reduce our reliance on antibiotics. Furthermore, marketplace opportunities have been developed to provide pork meeting various "Antibiotic Free" certification programs. Raised Without Antibiotics (RWA) is a certification that assures consumers the animal products they buy have been produced without exposure to antibiotics. Premiums

are placed on pork products throughout this supply chain, providing producers the opportunity to participate in increased revenues. To evaluate the value proposition, producers must compare cost of production impacts to increased revenues, ultimately calculating the net profit impact. Partial budgets serve as a valuable economic evaluation modeling tool, allowing producers to compare future costs and revenues in both commercial and RWA scenarios.

2. RWA Cost Impact Estimates

Several published papers describe commercial herd impacts on biological performance and cost of production when converting to RWA production. These cost estimates are specific to the genotypes, nutrition programs, and processes in which the transition from conventional to RWA was made, but provide us some general guidelines which producers should find useful in evaluating the RWA value proposition in their herds.

Main et al[1] documented a $4.40/CWT cost of production increase over 14 months post-conversion with a monthly range of $1.61-$7.67/CWT. The increased cost of production was primarily driven by an observed deterioration in nursery average daily gain (ADG), caloric conversion efficiency (F:G) and most notably mortality (Figure 1). Consistent differences in finishing performance were not observed between RWA and conventional pigs. It is important to note that RWA pigs were also vegetarian-diet-fed in this program and raised without plasma, lactose, fish meal, bone meal or animal fat. Differences in piglet performance during lactation were not assessed.

	Nursery			Finishing	
	ADG, lb/d	F:G	Mortality, %	ADG, lb/d	Mortality, %
Minimum Monthly Impact Observed	0.11	0.34	-0.7	0.16	2.01
Maximum Monthly Impact Observed	-0.27	-0.60	-7.8	-0.08	-1.75
Mean Impact Observed	-0.05	-0.19	-4.7	0.03	-0.30

Figure 1: ADG, F:G and Mortality % Impacts in a three-site commercial production system

Wolter et al[2] reported an increased cost of production of 14-21% based on internal system models. Primary biologic performance impacts were provided through an internal randomized complete block wean-to-finish (WTF) trial comparing conventionally raised vs RWA pig performance. In this trial pigs were not converted to a vegetarian-diet-fed program. WTF biologic performance was statistically different for ADG, average daily feed intake (ADFI), caloric conversion efficiency (G:F) and morbidity and mortality % (Figure 2). While all production metrics have an impact on the economic evaluation, similar to Main et al, the most costly producer impacts were due to mortality.

Metric	Control	RWA	*P*-value
Body weight, lb			
Start	14.1	14.1	>0.1
End	281.3	283	>0.1
Within-pen CV, %			
Start	19.3	19.6	>0.1
End	9.8	10.2	>0.1
ADG, lb/day			
Live	1.75	1.68	<0.05
Carcass	1.28	1.22	<0.05
Average daily feed intake (lbs)	4.16	4.09	<0.05
G:F			
Live	0.421	0.412	<0.05
Carcass	0.307	0.299	<0.05
Morbidity and mortality, %	6.5	14.1	<0.05

Figure 2: ADG, G:F, Morbidity and mortality % Impacts in a Randomized Complete Block WTF Trial

3. RWA Revenue Impact Estimates

RWA revenue impacts will be the easiest and most accurate value proposition for a producer to calculate. These will be RWA program and producer specific and, as such, outside sources of RWA revenue impacts need not be critically considered. Most producers with high health herds can market 75-85% of pigs weaned into an RWA market with the remaining 15-25% not meeting RWA specifications at the time of marketing. Producers should specifically review consistency of packer demand for the program, and any seasonal or periodic decrease in packer demand should be calculated into the producer revenue estimates.

4. Partial Budgets

Producers considering any incremental change in cost of production or revenue often find a partial budget to be a useful tool. A partial budget helps producers evaluate the financial effect of their production and revenue changes. A partial budget only includes costs and revenues that will be changed. It does not consider the financial impacts in the business that are left unchanged. The change under consideration is evaluated for its ability to increase or decrease income in the producers operation.

Partial budgets are calculated on the principle that incremental performance and revenue changes have effects in one or more of the following; revenue increases, revenue decreases, cost of production decreases, and cost of production increases. The net effect of these changes will be the positive economic outcomes minus the negative economic outcomes. A positive net indicates that producer income will increase due to the change and the change is advisable. A negative net indicates the change will reduce producer income and the change is not advisable.

A partial budget consists of two columns, a subtotal for each column and a grand total. The left hand column has the items that increase income while the right hand column notes those that reduce income for a farm business. The budget can be divided into four parts.

4.1. Added Income

This is the first section in Column 1. Additional producer revenues are listed here. When deciding on a projected price/CWT, use packer information based on historical prices for the RWA program you are considering. Consider all stipulations the RWA program includes and estimate a percentage of pigs you feel comfortable will be qualified for this program at the time of harvest.

4.2. Added Costs

This is the first section of Column 2. List all increased cost of production expenses due to the change being considered. Reference values from published field experiences and trials are listed above. If you have reason to believe your situation will vary from those experiences, adjust these estimates accordingly. Calculating this either on a per CWT or per pig basis is fine, but be consistent in the units used so that the net value proposition is calculated accurately.

4.3. Reduced Costs

This is the second section of Column 1. Obvious items for inclusion in the section would be medication expenses no longer incurred.

4.4. Reduced Income

This is the second section in Column 2. Items to consider here include reductions in pigs sold to primary markets (RWA and Commercial markets).

4.5. Partial Budget Summary

Summarization of the above four partial budget components is the last step in partial budgeting. Total each of the two factors in column 1, repeat the process for column 2. Then take column 1 (added income/reduced cost) and subtract column 2 (increased costs/reduced income) to arrive at a projected net producer return from adoption of the change under consideration. A negative number indicates the change as considered will reduce producer profits. A positive number indicates that the change will increase producer profits.

5. Additional Considerations – Reasons for Current Antibiotic Usage and Technologies to Reduce Usage

Food animal veterinarians rely heavily on pathogen identification to influence antibiotic decisions. Advances in molecular diagnostics have provided us with technology to readily identify pathogens. Over the past 15 years, our ability to identify pathogens has greatly outpaced our understanding of their importance in disease. Acting with the animals' best interest in mind we often employ the precautionary principle and utilize the tools in our toolbox to immediately protect diseased animals with antibiotics. Losing or reducing access to these tools will require food animal veterinarians to improve our diagnosis and management of non-infectious disease. Technological resources will be required to more rapidly identify metabolic, auto-immune, traumatic and musculoskeletal disease and avoid antibiotic use in inappropriate cases.

The principles of precision agriculture should be employed to reduce antibiotic use. The vast majority of antibiotics ingested by animals are either converted into non-effective metabolites or distributed to non-target tissues. Technology to identify specific animals with infectious diseases and administer therapy in low doses directly to target tissues will result in a dramatic decrease in total antibiotic usage.

Successful RWA production programs will require improved cross-functional problem solving. Veterinarians, nutritionists and geneticists must work collaboratively to solve problems in a world with reduced antibiotic use. There is not only a technology resource need but also an academic resource need. Cross-functional programs must be developed to supplement the existing disciplines which have been rigidly defined over the last 50 years. The true leaders in health management in a world of limited antibiotic access will be those who best understand the complex interactions of genotype and environment.

References

[1]**Main, R.G et al** (2010). A Field Experience Implementing an Antibiotic-Free Program in a Commercial Production System. ISU Swine Disease Conference Proceedings 53-56.

[2]**Wolter, B. et al** (2016). Growth of a Pig Production Business; Consumer Challenges, Strategy and Opportunities. Leman Conference Proceedings