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INTRODUCTION TO RESEARCH WRITING: THE CaRS MODEL

Research, Learning, and Writing

Students intuitively realize that **education** is a key mission of universities. However, not all students are aware that teaching is only one part of their professors' work. **Research** is another equally important occupation. Faculty organize themselves into broad areas like Mathematics and Music, Physical Sciences and Psychology, and from within those **disciplines**, conduct research which makes new contributions to human knowledge. This research is constrained by the **objects of study** in the discipline, the **methods** which scholars devise to study them, and the **ideologies, theories,** and **values** which inform scholars' worldviews.

Why should this matter to students? How does the research mission of the university affect the teaching mission? And what does any of this have to do with writing?

Most obviously, the fact that faculty organize themselves into disciplines usually means that students are organized into majors. The research constraints of the scholar then become the learning constraints of the student. In writing assignments, students are tasked with novice versions of the research-oriented **genres** which their instructors write professionally. In literary studies, this might mean writing a critical essay, whereas in public health, this might mean writing a policy report, and so forth. In this way, students are disciplined: they acquire specific types of knowledge about the world and are equipped with research competencies and critical literacies as relevant to their chosen field.

The Basic Research Situation (The CaRS Model)

What does the basic research situation look like when it is represented in writing? An influential scholar in the field of English for Academic Purposes, John Swales (1990), conducted an **empirical review** of **research article introductions** published across the disciplines. Swales codified his findings in the 3-step "**Create-a-Research-Space**" or "CaRS" Model. According to Swales, researchers represent their research in writing by:

1. Demonstrating familiarity with the existing state of knowledge in their field;
2. Identifying a gap or deficit in the pre-existing state of knowledge; and
3. Making an original contribution which fills the gap and/or addresses the deficit.

Undergraduates are not expected to create new knowledge. However, because research-oriented values, norms, and practices inform their assignments, the CaRS model can be a helpful guide.

One can also learn by studying professional examples of academic writing. Let's do that now. The following two pages of this document are excerpted from a published, **peer-reviewed** research article. As is true of many research articles, the subject may seem niche or obscure to a general reader, but it is sure to be consequential to the intended specialist **audience**. For our purposes, it isn't necessary to understand the discipline-specific **jargon** or even the nature of the experiment under discussion. Instead, by applying the CaRS model (see the annotations), we can appreciate the structures and strategies used by the authors to represent their research in writing. These are the same strategies which Swales found that scholars use again and again, across the disciplines, to communicate their research. They are also strategies which students can use in their own research-oriented writing.

Note that, in the following example, the CaRS moves are clearly demarcated. However, the moves may sometimes overlap or occur recursively, and they can also occur out of order. Even so, almost by definition, for a research article to be a research article, all 3 moves will occur.

Reference

Swales, J. (1990). *Genre Analysis: English in Academic and Research Settings*. Cambridge UP.

poultry

MDPI

Article

Individual and Combined Effects of a Direct-Fed Microbial and Calcium Butyrate on Growth Performance, Intestinal Histology and Gut Microbiota of Broiler Chickens

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Abstract: This study evaluated the effects of a *Bacillus* direct-fed microbial and microencapsulated calcium butyrate fed individually and in combination, as compared to an antibiotic growth promoter, on growth performance, processing characteristics, intestinal morphology, and intestinal microbiota of Ross 708 broilers reared from 0 to 47 d post-hatch. Dietary treatments included: (1) a negative control with no antimicrobial (NC), (2) a positive control diet containing bacitracin methylene disalicylate (PC), (3) a diet containing a *Bacillus* direct-fed microbial (CS), (4) a diet containing microencapsulated calcium butyrate (BP), and (5) a diet containing both CS and BP. Treatments were replicated with 10 pens of 20 birds each. From 0 to 15 d post-hatch, the FCR of broilers fed the PC, CS, BP, and CS + BP diets were lower ($p < 0.05$) than those fed the NC diet, but treatment effects ($p > 0.05$) were not observed on subsequent performance. BP supplementation improved ($p < 0.05$) total breast meat weight and yield at processing. Intestinal histology was not influenced ($p > 0.05$) by the treatment. Analysis of the jejunal microbiota collected at 15 d post-hatch revealed that the genus SMB53 was significantly lower for the CS group, and *Sporanaerobacter* was lower in the CS and CS + BP groups compared with the NC ($p < 0.05$). The jejunal microbiota from broilers in the CS + BP group had higher ($p < 0.05$) alpha and beta diversities compared with broilers fed the NC and CS diets. The results reflected synergistic effects between CS and BP in modulating the jejunal microbiota at 15 d that may have been related to enhanced feed efficiency (i.e., lower FCR) observed during this period.

Keywords: butyrate; *Bacillus*; broiler chicken; growth performance; processing characteristics; gut microbiota

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CARS MOVE #1: INTRODUCE THE STATE OF KNOWLEDGE

1. Introduction

Global poultry production is continuously growing and industrializing as a result of increased population size, purchasing capacity, and urbanization [1]. Among animal-derived foods, poultry meat is expected to increase the most (121%) by 2050 to meet dietary protein demands of the growing human population, which is projected to reach 9.6 billion [2]. Intensive poultry farming practices can increase the prevalence of enteric diseases such as necrotic enteritis and *Salmonella* infections. Antibiotics were traditionally used as a prophylactic measure to prevent these infections as well as to improve growth rate and feed efficiency of broilers [3,4]. However, increasing concerns regarding the development of antimicrobial resistance led to a ban on the use of antibiotic growth promoters in the EU beginning 1 January 2006 (EC Regulation No. 1831/2003), and subsequent restrictions were enacted in several non-EU countries, including the US (FDA Guidance #213).

As reviewed by Huyghebaert et al. [4], numerous products were initially considered for their ability to enhance broiler health and performance, with varying degrees of success, following the removal of in-feed antibiotic growth promoters from poultry production

CARS MOVE #2: DEMONSTRATE THE NEED FOR ORIGINAL RESEARCH

CARS MOVE #3: MAKE A NEW CONTRIBUTION TO KNOWLEDGE

systems. Direct-fed microbials have continued to receive much attention in this regard due to their ability to reduce pathogenic stress and exert antioxidant properties which can reinforce immune status [5–8]. Additionally, butyric acid, which is a short-chain fatty acid produced endogenously by microbial fermentation, promotes epithelial cell development and has been demonstrated to improve gastrointestinal health and performance of broilers through exogenous supplementation [9,10]. Due to the different mechanisms by which these additives might influence the intestinal environment, there is a potential for both antagonistic or synergistic effects between direct-fed microbials and butyric acid. Therefore, it is critical to assess the efficacy of these products when they are supplemented individually and in combination.

The objective of this study was to investigate the effects of a *Bacillus* subtilis direct-fed microbial and microencapsulated calcium butyrate, individually and in combination, and an in-feed antibiotic (bacitracin methylene disalicylate) on the performance, processing characteristics, intestinal histology, and jejunal microbiota of broilers. Due to the central roles of the gut microbiota in diverse aspects of host biology, we hypothesized that improved broiler performance conferred by these additives would be associated with changes in gut microbiota, providing insight into the mechanisms by which these potential antibiotics alternatives can benefit animal health and performance.

2. Materials and Methods

2.1. Broiler Husbandry and Dietary Treatments

Female Ross × Ross 708 broiler chicks were obtained from a commercial broiler hatchery on the day of hatch and transported to the University of Arkansas Division of Agriculture Poultry Research Farm. Upon arrival, chicks were group-weighed and randomly distributed to 50 floor pens on used (multiple flocks) litter top-dressed with fresh pine shavings (20 birds per pen; 0.093 m^2 per bird). Birds were monitored daily for morbidity and mortality, and access to feed and water was provided ad libitum throughout the experiment. The lighting schedule and temperature targets were adjusted according to management guidelines provided by the primary breeder [11], and daily temperatures were verified in the house to ensure bird comfort. The live-bird phase of the experiment was conducted from September to October.

Broiler chicks were assigned to one of five dietary treatment groups (10 replicate pens per group) that included a negative control diet with no test additives (NC), a positive control diet with 50 mg/kg of bacitracin methylene disalicylate (Zoetis, Florham Park, NJ, USA; PC), and three experimental diets containing either 3.4×10^8 spores/g of *Bacillus* subtilis PB6 (CLOSTAT, Kemin Industries, Des Moines, IA, USA; CS), encapsulated calcium butyrate (ButiPEARL, Kemin Industries, Des Moines, IA, USA; BP), or both (CS + BP). The addition of *B. subtilis* PB6 and encapsulated calcium butyrate was calculated to provide 1.7×10^8 spores/kg and 131.1 mg butyrate/kg to the finished feeds, respectively. Test additives were added at the expense of sand in the basal diet. Experimental diets were fed in three phases that included starter (0 to 15 d), grower (15 to 29 d), and finisher (29 to 47 d) feeds. Dietary nutrient specifications (Table 1) of the basal diets were based on recommendations for Ross 708 broilers [12]. The starter diet was pelleted and crumbled, whereas the grower and finisher diets were fed as pellets.

2.2. Broiler Live Performance and Processing Yields

At the end of the starter, grower, and finisher feeding phases, all birds and feeders were weighed to determine body weight gain (BWG), feed intake (FI), and mortality-corrected feed conversion ratio (FCR) to assess growth performance. At 48 d post-hatch, five birds per pen that had been previously randomly selected and wing-banded were caught for processing following an overnight feed withdrawal. All birds were individually weighed at the back dock immediately before processing. Birds were electrically stunned, exsanguinated, scalded, and defeathered. After subsequent removal of heads and feet, carcasses were rehung on a mechanical shackle line and eviscerated. Hot carcass and