Current Studies in Veterinary Nutrition and Nutritional Diseases

Editor

Tahir BALEVİ

Selçuk University

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Chapter 1

NUTRITION AND THEIR IMPLICATIONS FOR ANIMAL HEALTH, PRODUCT QUALITY, FOOD SAFETY, AND SUSTAINABILITY

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Introduction

The qualitative attributes of poultry meat, eggs, and products represent a critical paradigm in the contemporary food industry, directly dictating consumer satisfaction and nutritional efficacy. The production system, encompassing strategic breeding genetics, optimized nutritional feed formulations, and advanced post-harvest processing stages, exerts a deterministic influence on the definitive flavor profiles, textural properties, and physicochemical compositions of the final products. Furthermore, recent technological milestones in selective breeding practices, precision animal nutrition, and innovative processing methodologies have substantially synergized to elevate product quality, fortify food safety protocols, and prolong shelf-life stability. Within the global food chain, poultry products represent an important source of high-quality animal protein, making the control of product quality, microbiological safety, nutritional value, and shelf life essential from primary production to final consumption. Emulsifiers, pH control agents, antimicrobials, antioxidants, binders, enzymes, and bioactive compounds are frequently used in poultry diets. These additives largely promote the bird's development and egg-laying ability, avoid illness, and enhance feed utilization. These additives utilized in feed must be authorized for application and utilized as instructed regarding inclusion levels and duration (1). Additives are precise to the species and age of the birds being fed. Among these additives,

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chain, linking changes in the bird to measurable improvements in product safety, shelf life, consumer acceptance, and environmental performance. More evidence from long-term, commercial-scale trials is therefore needed to confirm whether results obtained under controlled experimental conditions can be reproduced in practical production systems.

Future research should move beyond the evaluation of individual additives and focus on well-characterized combinations and precision-based nutritional strategies. Standardized characterization of active compounds, dose–response studies, multi-omics approaches, and integration of microbiome, metabolomic, and nutritional data could help explain variability among responses and identify suitable combinations for specific production conditions. Research should also incorporate food-safety validation, residue assessment, life-cycle considerations, and economic analyses. For industry, the most realistic approach is likely to be the integration of bioactive components into broader strategies involving good farming practices, biosecurity, vaccination, HACCP-based controls, and responsible antimicrobial use. Such an integrated approach could facilitate the development of poultry production systems that simultaneously address animal performance, product quality, food safety, responsible antimicrobial use, and sustainability.

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Chapter 2

MICRO- AND NANOPLASTICS IN RUMINANTS: DEVELOPMENT OF A MATHEMATICAL FRAMEWORK LINKING ENVIRONMENTAL EXPOSURE, GASTROINTESTINAL UPTAKE, AND BIOLOGICAL EFFECTS

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Introduction

Plastics are regarded today as some of the most widely used and versatile materials of the modern era. In parallel with the growth of the global population, plastic production has expanded dramatically to meet increasing demand. Since 1950, when global production first exceeded a few million tonnes, it has continued to grow by approximately 5 – 9% per year and is projected to reach nearly 1.1 billion tons by 2050 (1). Around one-third of all plastics produced each year are designed for single use and are therefore discarded within roughly 12 months after production (2). It is estimated that nearly 10% of all plastics ever produced have already contaminated the world's oceans (3).

Incineration represents one route for plastic-waste disposal; however, the process can generate toxic compounds such as furans and dioxins that pose risks to living organisms (4). Moreover, inadequate waste management systems and the widespread use of landfilling have contributed to plastic contamination of terrestrial environments. Plastics are estimated to account for roughly 16% of the total waste present in landfill sites worldwide (5).

These shortcoming in waste management highlight that plastic pollution is not merely a consequence of improper disposal but is also associated with the

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Chapter 3

THE ROLE OF POLYUNSATURATED FATTY ACIDS IN REGULATING MALE REPRODUCTIVE FUNCTIONS IN RUMINANTS

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Introduction

Throughout human history, animal products have played a fundamental role in human nutrition across different cultures and societies. As humanity transitioned from a hunter-gatherer lifestyle to a production-based way of living, various livestock breeding methods (e.g., extensive and intensive systems) were developed to ensure continued to access animal protein and to meet the demands of growing populations. In these breeding systems, high-yielding animals have been selected to enhance competitiveness and fulfill nutritional needs (1). The selection of high-yielding animals has necessitated genetic improvement programs to meet the increasing global demand for animal protein. Due to the rising world population, current meat and milk production must nearly double by 2050 to satisfy future demand (2). These breeding programs have led to the development of highly efficient breeding stock capable of converting natural resources into animal products effectively, thereby contributing to sustainable agricultural practices. Nevertheless, despite these advancements, no viable alternative has been found to counteract the numerical expansion of livestock worldwide. For instance, a 20-year study conducted in Denmark revealed that although the number of farms decreased by50%, the number of animals per farm increased 3.7 times (3). While improvements in productivity are evident, the inevitable increase in animal numbers raises significant environmental concerns. To ensure both accessibility to animal protein and economic viability for producers, it is essential

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Mitochondria produce ROS at physiological concentrations, and these molecules regulate redox-related signaling pathways (125). Mitochondrial DNA is particularly susceptible to oxidative damage, which can impair sperm function (83,126). Studies have shown that dietary PUFA supplementation may alleviate the adverse effects of cryopreservation on mitochondria (127–130).

Conclusion

Polyunsaturated fatty acids play important roles in testicular development, spermatogenesis, sperm membrane organization, and the maintenance of reproductive functions in ruminants. These effects are mediated through several interconnected mechanisms, including hormonal regulation, testicular cell function, membrane dynamics, energy metabolism, and the production of bioactive lipid mediators. However, ruminal biohydrogenation of dietary PUFAs can alter both the amount and fatty acid profile of lipids reaching the tissues, thereby limiting the anticipated biological response. Rumen-protection methods therefore represent important nutritional strategies for increasing PUFA bioavailability. Nevertheless, the efficacy of supplementation varies according to the animal species, developmental stage, fatty acid source, dose and duration of administration, and the balance between n-3 and n-6 PUFAs. Furthermore, the susceptibility of PUFAs to oxidation necessitates an appropriate balance between supporting membrane function and limiting lipid peroxidation, particularly under cryopreservation conditions. The success of PUFA supplementation should therefore be determined by jointly evaluating changes in the fatty acid composition of spermatozoa, testicular structure, functional semen parameters, and direct measures of fertility. Future studies should focus on identifying species- and physiological stage-specific supplementation strategies and evaluating their long-term reproductive outcomes.

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Chapter 4

THE RELATIONSHIP BETWEEN MICROBIOTA AND NUTRITION IN PET OBESITY

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1. INTRODUCTION

More than half of the dogs and cats living in developed countries are now overweight or obese. Reported prevalence in dogs ranges from 34% to 63% depending on the region, and roughly 60% of cats in the United States are estimated to carry excess body fat (1-3). Orthopaedic disease, insulin resistance and a measurable decline in quality of life accompany the condition.

Prevalence figures alone understate the problem. In a retrospective analysis of more than fifty thousand neutered client-owned dogs, animals that were overweight in middle age carried a higher mortality risk in all twelve breeds examined, and median lifespan was shorter. The difference was largest in the Yorkshire Terrier, where it approached two and a half years (4). Lifelong controlled energy restriction in Labrador Retrievers had earlier been shown to extend lifespan and to delay the onset of age-related chronic disease (5). In cats, the nine-point body condition score is strongly associated with survival (6). The cost of obesity, in other words, can be counted in years.

Conventionally, obesity is treated as a problem of energy balance. Energy consumed in excess of expenditure is deposited as adipose tissue, and

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microbiota has been demonstrated robustly. That obesity is associated with the microbiota has been demonstrated reasonably. That the microbiota causes obesity, or that altering it treats obesity in dogs and cats, has not been demonstrated.

The distance between these three statements defines the research programme facing the field. The studies that would close it are neither expensive nor complex: designs that separate energy allowance from dietary composition, that measure body composition, and that follow animals for long enough. The practical implication is that obesity management should continue to rest on a measured energy deficit, with microbiota-targeted nutritional approaches positioned as an adjunct that supports that foundation and that operates chiefly through the design of the fermentable fibre fraction. Until those studies are done, the microbiota will not be a prescribable target in canine and feline obesity.

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Chapter 5

TEMPORAL DISSOCIATION BETWEEN MICROBIAL AND EPITHELIAL ADAPTATION IN SUBACUTE RUMINAL ACIDOSIS: MECHANISMS AND NUTRITIONAL IMPLICATIONS

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1. Introduction

Ruminal acidosis has been the subject of substantive review for more than two decades (1-6). Across this literature the nutritional narrative has been remarkably stable. Cattle are fed diets rich in rapidly fermentable carbohydrate to meet energy demands that forage alone cannot satisfy; short-chain fatty acids (SCFA) accumulate faster than they are neutralised and absorbed; ruminal pH falls below a critical value for a critical duration; fibre digestion is impaired, the microbial community is disturbed, the epithelium is damaged, and a cascade of systemic consequences follows. Prevention is framed accordingly, as a formulation exercise: an appropriate forage-to-concentrate ratio, sufficient physically effective and potentially fermentable neutral detergent fibre, controlled starch degradability, and adjunctive use of buffers, ionophores, or microbial and phytogenic additives (6).

The framing is correct as far as it goes, and the practical recommendations derived from it are sound. What it does not explain is why SARA remains common

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Chapter 6

SUPPLEMENTAL FEEDING PROPYLENE GLYCOL OF DAIRY COWS IN EARLY POSTPARTUM-EFFECTS ON BODY CONDITION SCORE, BETA-HYDROXYBUTYRATE, NON-ESTERIFIED FATTY ACIDS AND GLUCOSE CONCENTRATIONS

Orhan YALÇIN[1]
Recep GÜMÜŞ[2]

Introduction

The period in dairy cows that begins approximately three weeks before calving and continues until three weeks after calving, during which physiological and metabolic changes are most intense, is defined as the transition period (1). The three-week interval prior to parturition is referred to as the pre-partum period, while the three weeks following calving are termed the post-partum period (2). The post-partum period in dairy cows represents a metabolically and physiologically critical stage (3). During this time, animals struggle to meet the increased energy demands associated with the onset of lactation, in addition to coping with the hormonal and metabolic changes triggered by parturition (4). This condition, known as negative energy balance (NEB), is particularly common in high-producing dairy cows (5). Indeed, NEB during the post-partum period can lead to excessive body condition loss, reduced production of reproductive and metabolic hormones, impaired fertility, and early embryonic loss, thereby adversely affecting both animal health and milk productivity (6).

Propylene glycol ($C_3H_8O_2$) is a colorless, odorless alcohol with a slightly sweet taste. When administered orally to cattle, it is converted into propionic acid in the rumen, thereby contributing to gluconeogenesis (7). It has been reported that the

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group treated with PG at a daily dose of 300 mL, BCS values were higher in the PG-treated group compared to the control group at weeks 5 and 12 of lactation. According to Smith et al. (28), cows with higher BCS are more prone to lower dry matter intake and greater body weight loss after calving. In the current study, PG supplementation had no effect on BCS changes up to postpartum day 21, indicating that it did not alleviate the decline in BCS during early lactation. These findings are in agreement with previous reports in the literature (27,29).

Conclusions

In this study, the effects of oral PG administered during the early postpartum period on certain metabolic parameters and body condition score in dairy cows were investigated. The findings indicate that PG significantly reduced BHBA levels, which may be interpreted as evidence that it can suppress ketone body formation and thereby decrease the risk of subclinical ketosis. However, PG administration did not produce a statistically significant short-term change in NEFA, glucose, or BCS values. These results suggest that while PG may serve as a supportive compound in reducing metabolic stress during the early postpartum period, it does not lead to marked short-term improvements in other metabolic indicators. Future studies evaluating PG administration over longer durations and with different dosing protocols would be valuable in clarifying not only its short-term but also its medium- and long-term metabolic effects.

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Chapter 7

ANATOLIAN WATER BUFFALO (BUBALUS BUBALIS): POPULATION DYNAMICS, PHYSIOLOGICAL CHARACTERISTICS, PRODUCTION PERFORMANCE, AND PRODUCT QUALITY

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INTRODUCTION

Water buffaloes belong to the Bovidae family of even-toed ruminants. Water buffaloes are classified as Asian buffaloes (*Bubalina*) and African buffaloes (*Syncerina*) (1). Originating from domestic and wild forms, there are 74 distinct breeds of water buffaloes. These breeds are broadly divided into two categories: Swamp buffaloes and River buffaloes. While Swamp buffaloes are used as draft animals, milk and meat yields are predominant in River buffaloes.

HISTORY

Their native habitat encompasses India, China, and Southeast Asia. True water buffaloes are originally of Asian origin. It is believed that the word "manda" [water buffalo] originates from the geographical region of Manda in India. Due to their affinity for water and mud, they are referred to as "water buffalo" in English. The American bison or Western American buffalo (bison) is not a true water buffalo. They were introduced to the Near East and North Africa around 600 BC. They entered Europe during the Middle Ages via the Crusades, forming the herds present in modern-day Italy and Bulgaria. In recent times, they have been introduced to South and Central America, Micronesia, and Australia. Water buffaloes are highly popular in China and Brunei (1).

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To secure the sustainability and profitability of water buffalo husbandry, future strategies must focus on:

- **Expanding and Modernizing Breeding Programs:** Institutional models such as the "Community-Based Breeding Project" should be scaled up, incorporating advanced molecular tools, genomic selection, and reproductive biotechnologies (e.g., artificial insemination and embryo transfer) to accelerate genetic gain for milk yield and growth traits.
- **Precision Nutrition and Feeding Strategies:** Establishing species-specific nutrient requirements is essential to optimize rumen fermentation, improve protein utilization efficiency, and enhance milk fat and protein profiles without compromising animal health.
- **Value-Added Processing and Branding:** Promoting functional dairy products (such as high-quality mozzarella and traditional clotted cream) and lean, tender buffalo meat can create high-margin niche markets, thereby incentivizing young entrepreneurs and investors to establish modern dairy buffalo enterprises.
- **Climate Resilience and Welfare:** Further research into thermal stress management, microclimate control in housing, and wallowing alternatives will be critical to safeguarding production performance under changing global climatic conditions.

In conclusion, transforming Anatolian water buffalo farming from traditional family-scale operations into sustainable, technology-driven commercial enterprises is imperative. Comprehensive scientific research, backed by public-private sector collaborations, will play a decisive role in preserving this unique genetic resource while contributing to sustainable livestock production and food security.

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Chapter 8

USE OF PROTEIN, ENERGY, AND MINERAL BLOCKS IN DAIRY COWS UNDER VILLAGE CONDITIONS

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Tahir BALEVİ[2]

Introduction

The fundamental requirement for conducting dairy cattle production in an economical and sustainable manner is to feed animals with balanced diets formulated according to their genetic potential. As metabolic activity increases in high-yielding dairy cows, their requirements for energy, protein, minerals, and vitamins also increase. The energy and protein levels in the diet are essential for maintenance, milk production, proliferation of rumen microorganisms, and microbial protein synthesis (1, 2). Particularly at the beginning of lactation, the rapid increase in milk yield, while dry matter intake does not increase at the same rate, results in a negative energy balance in dairy cows. Consequently, mobilization of body weight and body fat reserves occurs, leading to metabolic disorders and reproductive problems (1, 3, 4).

Proteins are utilized for the formation and renewal of body tissues, synthesis of enzymes and hormones, functioning of the immune system, reproductive performance, muscle development, and particularly the synthesis of milk proteins. A proportion of dietary protein is degraded by microorganisms in the rumen and converted into microbial protein, which is subsequently absorbed in the small intestine (5). Therefore, rumen-degradable protein, rumen-undegradable protein, microbial protein, and metabolizable protein have gained increasing importance in modern dairy cattle nutrition (1, 5). In dairy cattle diets, the amino acid profile is more important than the crude protein concentration alone. Amino acids such

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Chapter 9

FEED ADDITIVE APPLICATIONS IN BROILERS WITHIN THE ONE HEALTH APPROACH

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Introduction

One Health is defined as ***"the collaborative effort of multiple disciplines to achieve optimal health."*** One major public health issue that should be addressed through the One Health approach is antimicrobial resistance. Foodborne zoonoses are important not only for their potential to cause foodborne outbreaks but also for the antimicrobial resistance they may induce. Due to their potential to cause antimicrobial resistance, *Campylobacter* and *Salmonella* spp. were included in the World Health Organization's 2017 list of priority pathogens as high-priority pathogens for which new classes of antibiotics need to be developed (1).

At this stage, the production of feed in accordance with hygiene requirements, the appropriate use of feed additives, and the assurance of feed safety constitute the starting point of the entire chain in reducing foodborne *Salmonella* spp. and *Campylobacter* spp, infections of public health concern and combating the associated antimicrobial resistance. Therefore, implementing strategies that also include feed additives is important.

Current Status and Control Strategies

The European Food Safety Authority (EFSA) reports that *Campylobacter* spp. have been the leading cause of foodborne infections in humans since 2005, followed by *Salmonella* infections as the second most common cause. Table 1 presents the numbers of reported cases of campylobacteriosis and salmonellosis in humans,

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of new feed additives and increased use of feed additives in animal nutrition (13). In addition, the EU 2023–2030 roadmap for combating AMR emphasized that reducing antimicrobial use would be important for preventing AMR by limiting the spread of antimicrobial-resistant bacteria and genes into the food chain and the environment through food-producing animals.

For these reasons, the individual or combined use of feed additives such as probiotics, prebiotics, organic acids, essential oils, aromatic plants and their extracts, and research conducted for this purpose have become increasingly important from a One Health perspective. The appropriate use of feed additives is important for achieving beneficial effects in combating foodborne zoonoses and antimicrobial resistance and for improving performance.

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