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NEURAL AND NEUROENDOCRINE REGULATION OF FEED INTAKE AND ENERGY METABOLISM: IMPLICATIONS OF STRESS PHYSIOLOGY FOR ANIMAL PRODUCTION

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Feed intake and energy metabolism are fundamental determinants of animal health, welfare, and productivity. Although feeding and energy expenditure are traditionally viewed primarily as consequences of nutrient availability and peripheral metabolic demands, current evidence demonstrates that feeding and energy expenditure are regulated by distributed networks within the central nervous system integrating metabolic, endocrine, visceral and environmental signals. The hypothalamus and brainstem play central roles in this process, coordinating autonomic, endocrine and behavioural responses according to the physiological state of the animal. An important emerging concept is that the brain regulates not only energy intake and expenditure, but also the allocation of limited metabolic resources among competing physiological functions**.** Growth, reproduction, immune defence, thermoregulation, locomotion and stress adaptation therefore compete for a common metabolic resource pool. Stress represents a particularly important physiological state in this context. Acute stress activates sympathetic and hypothalamic–pituitary–adrenal pathways, rapidly increasing energy mobilization, cardiovascular function and thermogenesis while temporarily suppressing feeding and anabolic processes. Chronic or repeated stress can result in sustained changes in energy expenditure, feed intake and gastrointestinal function as well as reproductive and growth performance. Brown adipose tissue is identified as an important effector organ in the regulation of metabolic allocation in stress. This review summarises current concepts in the central regulation of feeding and metabolism, with particular emphasis on the integration of stress-responsive neural circuits, autonomic pathways, glucocorticoids, and peripheral metabolic organs. The bidirectional interaction between the brain, gastrointestinal tract and microbiota is also considered. Understanding stress as a central regulator of energy allocation provides a physiological framework for interpreting production losses and highlights the importance of stress resilience, animal welfare, and environmental management for sustainable livestock production.

Keywords: feed intake, energy metabolism, neuroendocrine regulation, stress physiology, livestock

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OXIDATIVE STRESS AND INFLAMMATION OF PIGLETS WITH A FOCUS ON INTESTINAL ROBUSTNESS AND RESILIENCE

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Infectious diseases in the gut of weaned pigs are responsible for the high use of antibiotics, and to avoid the development of antimicrobial resistance there is a demand for identifying alternative strategies to enhance animal disease resistance. Oxidative stress and inflammation are naturally occurring host mechanisms to combat infectious disease; however, when these mechanisms get out of control, this can result in chronic inflammation and severe intestinal pathogenic conditions. Early weaning of pigs may induce intestinal oxidative stress, which can contribute to intestinal dysfunction. There are several opportunities to combat uncontrolled oxidative stress and inflammation in the gut of pigs via dietary strategies. In the present review, mechanisms by which antioxidative vitamins and trace elements and polyphenols may prevent oxidative stress in pigs are presented. It is recommended to consider their biological activities and their mode of action in the intestine to consider their potential applications as dietary supplements during the pre- and post-weaning period. The perspective is that enhanced intestinal robustness and resilience of piglets are probably not obtained by a single substance; it is rather recommended to consider an antioxidant vehicle, in which the biological functions of various bioactive substances are composed to meet the dynamic changes in the intestinal environment of the pigs during the weaning transition.

Keywords: piglets, weaning, oxidative stress, intestinal health, dietary antioxidants

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NUTRITIONAL AND MANAGERIAL STRATEGIES TO ALLEVIATE STRESS AND IMPROVE HEALTH AND PRODUCTIVITY IN BEEF CATTLE AND DAIRY RUMINANTS: A REVIEW

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Stress is a pervasive and multifactorial challenge in modern livestock production, with heat stress, transportation, pathogen exposure, weaning, and disrupted photoperiod among its principal stressors. Chronic and acute stress can compromise animal welfare, immune competence, reproductive performance, and product quality, and are expected to intensify under ongoing climate change. This review integrates recent evidence on strategies to mitigate stress and its downstream consequences in cattle, spanning early biochemical and genomic biomarkers for disease-risk prediction, genetic selection for resilience, behavioural and social management strategies, photoperiod and lighting interventions, and, most extensively, targeted dietary supplementation with bioactive plant-derived feedstuffs. Particular emphasis is placed on three nutritional strategies studied in Mediterranean beef and dairy production systems: dietary inclusion of pomegranate (*Punica granatum*) peel by-products, Mediterranean woodland foliage browsing, and ensiled *Moringa oleifera*. Across these interventions, polyphenol- and antioxidant-rich feedstuffs consistently improved oxidative status, immune and udder health indices, rumen fermentation efficiency, and milk yield and milk composition, while browsing on tannin-rich woodland vegetation conferred a measure of "environmental resistance" against tick-borne haemoparasites. Photoperiod management, specifically avoiding artificial light at night, was shown to enhance melatonin-associated antioxidant and immune status as reflected by lower milk somatic cell counts. Collectively, the reviewed evidence supports the integration of nutritional, genetic, and managerial tools as part of an integrated strategy for reducing stress-related morbidity and improving the sustainability of livestock production under increasingly challenging environmental conditions.

Keywords: ruminants, stress mitigation, dietary supplementation, plant bioactives, photoperiod

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NOVELTIES ABOUT STRESS EVALUATION IN NON-INVASIVE MATRICES IN PIGS

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Non-invasive biomarkers are increasingly important for objective and real-time assessment of stress, health, and welfare in modern pig production. Saliva has emerged as a particularly valuable diagnostic matrix because it can be collected repeatedly with minimal animal disturbance and reflects neuroendocrine, immune, and metabolic responses. This review summarizes recent advances in porcine sialochemistry, with emphasis on analytical validation, pre-analytical standardization, and the identification of novel biomarkers. Particular attention is given to salivary cortisol and cortisone as indicators of hypothalamic-pituitary-adrenal axis activity, including the cortisone-to-cortisol ratio as a marker of peripheral glucocorticoid regulation. Biomarkers of inflammation and innate immunity, including haptoglobin, calprotectin, myeloperoxidase, and S100A12, provide complementary information on systemic and mucosal responses to stress. Salivary alpha-amylase, chromogranin A, and esterase fractions offer additional indicators of sympathetic activation, pain, and acute stress. Emerging markers, including vimentin and oxytocin, may contribute to the assessment of positive welfare and emotional states. Redox biomarkers further enable differentiation between physiological adaptation and oxidative stress. Recent advances have also enabled the application of similar biomarker panels to porcine colostrum and milk for monitoring maternal physiology and passive immune transfer. Collectively, these developments support the integration of non-invasive biomarker panels into precision swine farming and welfare monitoring.

Keywords: pigs, saliva, non-invasive biomarkers, stress assessment, animal welfare

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PARTIAL REPLACEMENT OF CEREALS IN THE DIET OF PIGS WITH SUGARY FORMER FOODS: EFFECT ON PERFORMANCE[1]

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Former food products (FFPs), which are food industry by-products suitable for inclusion in animal feed, represent a sustainable strategy for recycling surplus food materials and supporting a circular bioeconomy. Their use in livestock diets can reduce food waste while replacing conventional feed ingredients. In a study evaluating the partial replacement of cereals in the diet of fattening pigs, two replacement levels were studied. Three treatments were applied: a control diet containing 0% FFP, and two treatments containing 20% and 40% sugary FFP, respectively. All experimental diets were formulated to be isoenergetic and isoproteic. Diets were fed during the growing (20 to 60 kg BW) and finishing (60 to 140 kg BW) stages of fattening. A total of 36 castrated pigs were used, with 12 pigs (assigned within a litter to each treatment) per treatment. Pigs were housed in a single pen equipped with automatic feeders that allowed individual *ad libitum* feed intake to be recorded. Overall, feeding with sugary FFPs had limited effects on growth performance. The only significant effect was during the grower period, when daily feed intake and daily gain decreased as sugary FFP inclusion increased. During the finishing periods, daily feed intake tended to decrease with increasing sugary FFP inclusion, but this did not affect daily gain and resulted in better feed conversion in the last finishing period. At the end of the fattening period, lower carcass weight and adiposity were observed in the 40% FFP group. Regarding technological meat quality, only the pH value measured 24 h postmortem was affected, with the 40% FFP group exhibiting a lower ultimate pH. Based on the results, the inclusion of sugary former food products at 40% of the diet appears to be the highest tested inclusion level for use during the early growth phase of pigs. However, no adverse effects on the measured parameters were observed during the later production stages, and overall, the results support the use of sugary former foods in pig production to reduce competition between feed and food uses. The evaluation of the effects on gut health is currently ongoing. Preliminary findings are consistent with the results presented here, i.e., they show limited effects.

Keywords: former food products, pigs, cereal replacement, growth performance, carcass quality

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[1] The results of this study have recently been published in Journal of Animal Physiology and Animal Nutrition (Čandek-Potokar et al., 2026) accessible at https://doi.org/10.1111/jpn.70090.

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EFFECT OF THE LEVEL OF INCLUSION OF INSOLUBLE FIBRE IN PIG DIETS

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In pig nutrition, dietary fibre plays an important role. It influences nutrient digestibility and consequently may affect performance. Appropriate levels support a favourable gut microbiota, regulate digesta passage, increase satiety and reduce digestive disorders. Unlike soluble fibre, insoluble fibre is fermented more slowly and mainly exerts influence on gut function through its physical properties. However, too high an inclusion level of fibre may impair nutrient digestibility, growth performance, and feed efficiency. In conventional grower–finisher diets, crude fibre typically ranges from 3.5 to 5.5%. Although an increase to 7–8% is generally considered to have no major adverse consequences, experimental evidence has yielded variable and study-dependent results. This study was conducted to assess the impact of elevated dietary inclusion levels of insoluble fibre, exceeding those commonly applied in commercial pig production, on growth performance and carcass quality under controlled experimental conditions. In our experiment, 16 finishing pigs of a conventional crossbreed (Landrace × Large White) were assigned to two treatment groups within litters and fed *ad libitum* via automatic feeders, allowing continuous individual monitoring of feed intake and body weight gain. Backfat and muscle thickness were also monitored ultrasonically during the trial. Starting at an average body weight of 29 kg, all pigs were first fed a common diet (4.3% crude fibre, 17.7% crude protein, 13.3 MJ ME/kg) for 5 weeks until reaching an average weight of 63 kg. For the following 9 weeks, one group received a conventional diet (CON; 4.3% crude fibre, 15.9% crude protein, 12.9 MJ ME/kg) while the other received a high-fibre diet (HFB; a cellulose supplement was added, resulting in 8.6% crude fibre, 15.8% crude protein, 12.0 MJ ME/kg). At the end of the finishing period, the pigs were slaughtered in a commercial abattoir, and carcass traits were recorded. During the experimental feeding period, the HFB group showed a 10% lower feed intake ($P = 0.06$) and a 15% lower metabolizable energy intake ($P = 0.01$) compared with the CON group (corresponding to 3.4 kg/day and 41.0 MJ ME compared with 3.8 kg/day and 48.6 MJ ME, respectively). Although final body weight was numerically lower in the HFB group (135.9 kg vs. 143.1 kg), the difference was not statistically significant ($P > 0.10$). Average daily gain was 8% lower in HFB pigs (1142 vs. 1240 g/day, $P = 0.01$). At the same time, ultrasonic measurements indicated a tendency toward lower *longissimus* muscle thickness ($P = 0.07$) and a lower daily muscle accretion rate (0.07 vs. 0.11 mm/day, $P = 0.06$) in the HFB group, with no significant effect of fibre level on fat deposition. After slaughter, most carcass traits (backfat thickness over the *gluteus medius* muscle and at the last rib, muscle thickness, carcass length, lean meat percentage) and pH measured 45 min after slaughter did not differ between groups ($P > 0.10$). The only exception was a tendency for lower backfat thickness at the withers in HFB pigs compared with CON pigs (36.4 vs. 40.3 mm, $P = 0.08$). Although the effects were relatively small, the results indicate that increasing dietary fibre negatively affected production performance. The main reason was reduced feed intake in the HFB group despite *ad libitum* feeding, suggesting that pigs did not sufficiently compensate for the reduced energy density of the diet by increasing feed intake.

Keywords: insoluble fibre, finishing pigs, feed intake, energy intake, carcass traits

Acknowledgements: This work was supported by the Slovenian Research and Innovation Agency and the Ministry of Agriculture, Forestry and Food (research programme P4-0133 and project V4-2201).

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MORINGA OLEIFERA MODULATES ENDOPLASMIC RETICULUM STRESS, ANTIOXIDANT DEFENCE, AND MITOCHONDRIAL FUNCTION IN GROWING LAMBS

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Environmental, nutritional, and metabolic challenges can disrupt cellular homeostasis and compromise production efficiency in farm animals. Functional forages rich in bioactive compounds may provide a sustainable strategy to enhance cellular resilience. *Moringa oleifera* is a nutritionally valuable forage with antioxidant (AO) and cytoprotective properties. This study evaluated whether dietary inclusion of ensiled *Moringa oleifera* modulates endoplasmic reticulum (ER) stress, endogenous AO and phase II defence responses, mitochondrial function, and production efficiency in growing lambs.

Two complementary 12-week experiments were conducted in Assaf × Dorper lambs during their growing period. In Experiment 1 (n = 30), lambs received diets containing either 10% ensiled *Moringa oleifera* mixed with crushed corn grains or 10% wheat silage as a control, with the remaining 90% provided as concentrate feed. Diets were comparable in terms of protein, energy, and NDF content. Production efficiency was assessed as the gain-to-feed ratio (G:F), and skeletal muscle biopsies were analysed for the expression of ER stress, AO, and phase II defence genes. In Experiment 2 (n = 10), mitochondrial function in the *biceps femoris* (BF) muscle was assessed using a Seahorse XFe24 analyser.

Feeding ensiled *Moringa oleifera* reduced the expression of ER stress-related genes, including the expression of HSPA5 ($P < 0.05$), ATF4 ($P < 0.001$), and ERN1 ($P = 0.03$), while increasing the expression of AO and phase II defence genes, including NQO1 ($P < 0.05$), GPX4 ($P < 0.01$), and HMOX1 ($P < 0.01$). These responses were accompanied by enhanced maximal respiration ($P<0.05$), ATP production ($P < 0.01$), and spare respiratory capacity ($P < 0.01$), together with an improved G:F ($P < 0.05$). Collectively, ensiled *Moringa oleifera* promoted coordinated adaptations involving ER stress, redox homeostasis, and mitochondrial function that may support cellular resilience and production efficiency in growing lambs.

Keywords: *Moringa oleifera*, growing lambs, endoplasmic reticulum stress, antioxidant defence, mitochondrial function

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EARLY METABOLIC CONSEQUENCES OF FUMONISIN EXPOSURE: EVALUATING THE POTENCY OF FB1, FB4, AND N-PALMITOYL-FB1

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Fumonisins are prevalent mycotoxins produced by *Fusarium* species that significantly disrupt sphingolipid metabolism by inhibiting ceramide synthase (CerS). While fumonisin B1 (FB1) is the most studied and abundant member, the toxicological profiles of analogues like fumonisin B4 (FB4) and the modified N-palmitoyl-FB1 (NpFB1) remain less characterised. Given the ubiquitous nature of these contaminants in maize and their emergence in temperate zones due to climate change, understanding the comparative potency of these analogues is essential for comprehensive food safety regulations. This study utilised 72 growing male HAN:Wist SPF rats divided into three experimental sets (FB1, FB4, and NpFB1). Each mycotoxin was administered intraperitoneally for five days at two dosages plus a control: a low dose (0.2 mg/kg bw/day, based on the FB1 NOAEL) and a high dose (1.0 mg/kg bw/day). Somatic parameters, including bodyweight progression and feed intake, were monitored daily. On day six, the rats were slaughtered and their livers were harvested for weighing, followed by shotgun lipidomic analysis to assess global metabolic remodelling. Somatic data revealed that FB1 was the most potent disruptor, with the high-dose group showing a significant lag in weight progression and gaining 50% less weight than controls. FB1 also caused a significant reduction in both absolute and relative liver weights. Lipidomic profiling via Principal Component Analysis (PCA) showed an independent separation of FB1 from FB4 and NpFB1, indicating a divergent toxicological trajectory. High-dose FB1 exposure led to a marked depression of ceramide (Cer) and a strong accumulation of lysophosphatidylglycerol (LPG) and lysophosphatidylethanolamine (LPE). In contrast, FB4 and NpFB1 showed a convergence in their metabolic impact, with NpFB1 generally inducing the smallest hepatic lipidomic changes. Notably, FB4 high-dose groups exhibited significantly higher feed intake on day five compared to controls, despite showing no changes in liver weight. The 5-day subacute exposure protocol confirmed that FB1 remains the most potent disruptor of growth and hepatic mass. However, the results suggest that FB4 has the potential for dose-dependent toxicological impact, highlighting the necessity for its independent evaluation in future risk assessments. The absence of mortality validates this model for investigating the early, subtle metabolic consequences of the fumonisin analogues.

Keywords: fumonisins, rats, sphingolipid metabolism, hepatic lipidomics, growth performance

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EFFECTS ON GROWTH PERFORMANCE AND ORGAN WEIGHTS IN WEANED PIGLETS FED ZEARALENONE-CONTAMINATED DIETS WITH OR WITHOUT *LACTOBACILLUS REUTERI*

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Zearalenone (ZEN), a secondary metabolite of *Fusarium* fungi, frequently contaminates cereal-based feed. While the European Commission has established a limit of 0.1 mg of ZEN/kg of feed for piglets, higher concentrations are frequently encountered. The study aimed to assess the growth performance and organ weights in weaned piglets in response to dietary ZEN contamination and the potential protective efficacy of the probiotic *Lactobacillus reuteri* (*L. reuteri*). Twenty-two weaned piglets with an initial body weight (IBW) of 10.27 ± 1.22 kg were randomly assigned to three dietary treatments for 28 days: control (C, basal diet), 0.8 mg/kg ZEN-contaminated basal diet (T) and 0.8 mg/kg ZEN-contaminated basal diet supplemented with 1 mL of 10^9 CFU/pig/day *L. reuteri* (TP). Normality of data distribution was determined by the Shapiro-Wilk test, and homogeneity of variances among treatment groups was assessed by Levene's test. Data were analysed using Analysis of Covariance (ANCOVA) in SPSS version 29.0.1.0, with IBW as a covariate. Results showed no statistically significant differences among the treatment groups, either in growth performance, including feed intake, body weight gain and gain-to-feed ratio ($P > 0.05$), or in absolute and relative organ weights of the liver, lungs and kidneys ($P > 0.05$). In conclusion, the results suggest that weaned piglets have stable growth performance and organ weights under a 0.8 mg/kg ZEN challenge during a 4-week subacute repeated-dose toxicity period. Moreover, supplementation with *L. reuteri* is a safe biological strategy in ZEN-contaminated feed, although its protective efficacy in maintaining production efficiency may only be evident under a more severe toxicological challenge.

Keywords: zearalenone, weaned piglets, *Lactobacillus reuteri*, growth performance, organ weights

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THE EFFECT OF ORAL INTAKE OF FUMONISIN B1 ON CAECAL BACTERIAL GENERA AND SCFA FERMENTATION IN WEANED PIGLETS

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Fumonisin B1 (FB1) represents one of the most prevalent mycotoxins worldwide. FB1 can elevate oxidative stress within the gut. Oxidative stress refers to an imbalance between the reactive oxygen species (ROS) and antioxidant production, mostly involving an increase in ROS. The FB1-induced oxidative stress and ROS may cause shifts in microbial structure. The abundance of strictly anaerobic and beneficial bacteria may decrease, in parallel with the colonisation of some pathogenic bacteria. Studies show that microbial eubiosis and normal fermentation processes play an important role in maintaining gut health by modulating the mucus layer and mitigating ROS production to sustain overall health.

Our aim was to investigate the effect of oral administration of FB1 (50 mg/kg feed) on the microbial genera and SCFA fermentation in the pig caecum. Twelve barrows were randomly allocated to the following groups: C, control (basal feed); F, fumonisin-treated (basal feed + FB1). The microbial composition was analysed by using the Nephele QIIME2 16S Amplicon pipeline. Statistical evaluation was performed using the paired Wilcoxon rank test after the Shapiro-Wilk normality test. Our results showed that in the FB1-treated group, some alterations in the relative abundances of microbial genera were detected. The added FB1 was associated with a lower abundance of the beneficial Ruminococcacea_other genus and the Bacilli_RF39 genus, the commensal Anaerovoracaceae_UCG-001 genus and the Enterorhabdus genus and increased the abundance of the commensal Catenisphaera genus, Anaerovoracacea_UCG-003 genus, Anaerovoracaceae_AD3011 genus, Erysipelotrichaceae_UCG-006 genus, and the opportunistic pathogen Eubacterium_nodatum_group genus and the pathogenic Campylobacter genus. Under FB1 exposure, the concentrations of isovalerate and isobutyrate significantly increased ($P < 0.05$) in the caecum, while the concentrations of acetate, propionate, butyrate and valerate remained unchanged ($P > 0.05$).

This study showed that oral administration of FB1 (50 mg/kg feed) induced changes in the relative abundances of some bacterial genera; moreover, it led to alterations in the concentrations of some bacterial fermentation products in the caecum of pigs.

Keywords: fumonisin, fermentation, microbiome, short-chain fatty acids

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STUDY OF THE PHYSIOLOGICAL AND INTESTINAL HEALTH EFFECTS OF EARLY-FEEDING SUPPLEMENTS PROVIDED AFTER HATCHING IN BROILER CHICKENS

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In this study, we investigated specialised early-feeding supplements for broiler chickens containing bioactive ingredients that have not, to our knowledge, previously been used for this purpose. Four early-feeding supplements were examined: Crispro, a dried black soldier fly (*Hermetia illucens*) larval product (Agroloop Hungary Ltd.); Liq-Biotic, a preparation containing liquid, plant-derived bioactive compounds (Garuda-Trade Ltd.); a probiotic containing the strain *Enterococcus faecium* L3 (Micromir Ltd.); and a postbiotic derived from *Bacillus mojavensis* (Biovéd 2005 Ltd.). Their effects were evaluated using agar diffusion and competition assays against selected Gram-positive and Gram-negative bacteria (*Staphylococcus aureus, Enterococcus cecorum, Escherichia coli* and *Salmonella enterica*). In the *in vitro* assays, Liq-Biotic inhibited the growth of *S. aureus* and *E. coli*, while the *B. mojavensis* postbiotic showed an inhibitory effect primarily against *E. cecorum*. The inhibition zones were generally small, but their presence suggested that the tested supplements affected bacterial growth under the applied in vitro conditions. The *E. faecium* L3 probiotic showed its most pronounced inhibitory effect against *S. aureus* in the spot-on assay. However, the cross-streak competition assay did not demonstrate a clear inhibitory effect against the tested bacteria. An *ex vivo* chicken caecum model was also used to investigate the effects of Liq-Biotic, *B. mojavensis* extract and Crispro on mixed intestinal microbial populations. Coliform bacteria and lactic acid bacteria (LAB) were cultured from caecal contents using selective media. None of the treatments substantially reduced the numbers of microorganisms recoverable from the caecal samples, although Liq-Biotic and *B. mojavensis* extract reduced coliform counts in fresh samples, while Crispro increased the coliform count in frozen samples. The tested materials therefore showed different effects depending on the test system and microbial group examined. Based on the agar diffusion results, Liq-Biotic showed the greatest antimicrobial effect among the tested supplements and was selected for further evaluation in combination with the *E. faecium* L3 probiotic and *B. mojavensis* extract for the planned *in vivo* trials. The results indicate the potential of the applied *in vitro* and *ex vivo* methods for preliminary screening of early-feeding supplements, while further animal studies are required to evaluate their effects under practical conditions.

Keywords: broiler chickens, early feeding, bioactive supplements, antimicrobial activity, caecal microbiota

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LIVE INSECT LARVAE IN POULTRY HUSBANDRY: WELFARE BENEFITS

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Insects are a natural part of free-range chickens' diet, but commercial housing often does not meet their need to forage. When chickens cannot forage, laying hens may develop severe feather pecking. Broilers can become inactive, leading to leg problems and skin issues. Giving chickens live insect larvae provides both nutrition and ongoing behavioural stimulation, since the birds must find, catch, and eat moving prey. This review looks at current research on using live black soldier fly larvae (*Hermetia illucens*) and yellow mealworm (*Tenebrio molitor*) larvae as enrichment for domestic chickens (*Gallus gallus domesticus*). For broilers, the main benefit is more activity and foraging, especially when larvae are scattered on the litter or given regularly. Other possible benefits include better litter quality, fewer cases of footpad dermatitis and hock burn, and less fearfulness; however, these results are not always consistent. In laying hens and dual-purpose breeds, live larvae have been linked to better feather condition, less severe feather pecking, reduced fear of people, and more nest use. Production parameters are usually maintained at moderate (5-10% of daily feed intake on a dry matter basis) inclusion levels of live larvae. Future research priorities should include commercial-scale trials and the measurement of physiological parameters and stress indicators.

Keywords: live insect larvae, poultry welfare, environmental enrichment, foraging behaviour, feather pecking

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NITRATE EXPOSURE IN DAIRY CATTLE: A 10-YEAR ASSESSMENT OF FORAGES AND DIETS IN HUNGARY

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Nitrate poisoning cases dominate the literature, while undetected chronic/subclinical exposures may result in impaired reproduction (abortions, reduced fertility), retarded growth, and decreased milk production. Evidence of its impact on the hormonal system is the fact that feeding 1600 ppm nitrate-N results in lower progesterone levels in early pregnant cows. Regarding nitrate, the EFSA Panel on Contaminants in the Food Chain (CONTAM Panel) established (Schrenk et al., 2020) a $BMDL_{10}$ of 64 mg nitrate/kg body weight per day for adult cattle, based on blood methaemoglobin (MetHb) levels that are not expected to cause clinical signs of hypoxia. This value approaches the reference level, indicating that at such exposure, the nitrate content of the diet requires attention. The threshold value previously applied in practice was considerably higher and is now subject to reevaluation. This paper primarily deals with feed-derived chronic nitrate exposure. The authors measured nitrate levels in the diets (TMR) of fresh cows (1-30 days postpartum, n=1,911), high-milking cows (35 - 45 kg/day/cow, n=11,276) and close-up cows (1-21 days prepartum, n=2,430) in Hungary. Additionally, nitrate concentrations in intensive grass silages (grown on arable land, n=822) and early-cut whole-crop rye silages (n=1,288) were detected. According to the results, 2.6–5.2% of the samples posed a risk according to the traditional threshold. However, the proportion of high-risk cases increases to 16.4–38.1% across different groups when the EFSA upper thresholds are applied. This indicates that chronic nitrate exposure cannot be ruled out, and its potential consequences (reduced appetite, early embryonic loss, abortion) could have been avoided by implementing stricter nitrate monitoring. Due to the early stage of harvest, the risk of elevated nitrate content remains a concern in the case of early-cut whole-crop cereal silages and intensive annual grass silages grown on arable land. The average nitrate content was 3.6 g/kg DM (n=1,290) in early-harvested whole-crop rye silages (cut in April, 2014-2022). It was 4.3 g/kg DM (n=736) in intensive annual grass silages between 2014 and 2022. This can be a limitation. Therefore, in the case of autumn-sown, early-harvested modern cereal and grass species, proper agrotechnical practices (dose, timing and form of fertilisers) and regular monitoring of nitrate content in silages are especially important as preventive management tools.

Keywords: nitrate exposure, dairy cattle, total mixed ration, grass silage, rye silage

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DIETARY ORANGE PEEL AS A PHYTOGENIC FEED ADDITIVE IN GROWING RABBIT DIETS: EFFECTS ON GROWTH PERFORMANCE, FEED EFFICIENCY AND NUTRIENT DIGESTIBILITY

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The search for sustainable phytogenic feed additives has increased interest in agricultural by-products such as orange peel as potential dietary supplements for livestock. This study evaluated the effects of dietary orange peel inclusion on growth performance, feed efficiency and nutrient digestibility in growing rabbits. Twenty-four weaned Hyla rabbits aged 5–6 weeks were randomly assigned to four dietary treatments with six rabbits per treatment. The treatments consisted of a basal diet without additive (T1), a basal diet supplemented with 4 g/kg of a commercial antimicrobial (T2), and basal diets supplemented with orange peel at 2 g/kg (T3) and 4 g/kg (T4). The feeding trial lasted seven weeks, during which feed and water were provided ad libitum. Growth performance was evaluated based on feed intake, body weight gain and feed conversion ratio (FCR). At the end of the feeding trial, three rabbits per treatment were used for an eight-day digestibility trial comprising three days of adaptation and five days of faecal collection. Feed and faecal samples were analysed for proximate composition, and data were subjected to one-way analysis of variance. Dietary treatment did not significantly affect final body weight, total weight gain or feed intake ($P > 0.05$). However, FCR differed significantly among treatments ($P = 0.04$), with the basal control recording the highest FCR (6.68), while the commercial antimicrobial treatment recorded the lowest FCR (3.74). The 2 g/kg orange peel treatment recorded an FCR of 4.25, indicating a favourable feed conversion response relative to the basal control. Nutrient digestibility of dry matter, crude protein, crude fibre, ash, ether extract and nitrogen-free extract was not significantly affected by dietary treatment ($P > 0.05$). The findings indicate that dietary orange peel, particularly at 2 g/kg, has potential as a phytogenic feed additive for supporting feed efficiency in growing rabbits without significant alteration of measured nutrient digestibility. Further studies with larger sample sizes and under defined production or stress conditions are warranted to clarify its mechanisms and broader applicability.

Keywords: orange peel; phytogenic feed additive; growing rabbits; feed conversion ratio; nutrient digestibility; feed efficiency

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EFFECT OF PREBIOTICS AND BENZOIC ACID FEED SUPPLEMENTS TO REPLACE THERAPEUTIC-DOSE ZINC OXIDE ON THE PERFORMANCE, NITROGEN RETENTION AND FAECAL CONSISTENCY OF WEANED PIGLETS

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Weaning stress and post-weaning anorexia negatively affect intestinal structure and function, particularly in the small intestine, impairing microbiota composition and nutrient utilisation. The aim of the study was to evaluate an alternative approach to replacing therapeutic-dose zinc oxide (ZnO) by reducing the protein content of the feed and supplementing it with a prebiotic and benzoic acid. The study was conducted with 24 weaned barrows in individual metabolic cages for 35 days. In the first phase, piglets were allocated to three dietary treatments: trtA: control, trtB: control+2000 ppm Zn (2.78 kg/t ZnO), trtC: commercial feed supplemented with prebiotics and benzoic acid. In the 2nd phase, all 24 barrows were fed with the same commercial diet. Piglets' performance parameters (live weight, feed intake, average daily gain and feed conversion ratio), faecal consistency and nitrogen (N) retention were investigated in both phases. There were no significant differences in performance, faecal consistency and N-retention of pigs during both experimental periods.

Keywords: weaned piglets; prebiotics; benzoic acid; zinc oxide; growth performance; nitrogen retention; faecal consistency

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RUMEN-PROTECTED B VITAMINS IMPROVED GROWTH POTENTIAL OF FEMALE DAIRY CALVES AFTER WEANING

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This study evaluated the effect of feeding a blend of rumen-protected B vitamins (RPBV; thiamine, folic acid, biotin, pyridoxine, and pantothenic acid) during the post-weaning phase. All calves were fed a liquid diet until weaning and were gradually introduced to a calf-starter and later a dry TMR starting at 10 days of age. This starter feeding phase continued for 2–3 weeks post-weaning, after which corn silage was incorporated into the TMR.

Female dairy calves entered the study approximately 10 days post-weaning (average age of 87.5±6.9 days; BW of 115.5±5.4 kg) and were followed for a subsequent 3-month feeding period. Calves were allocated to 8 consecutive batches of 16-24 calves and received either RPBV (3g/calf/day) or no RPBV (control) in alternating batches. Body weights (BW) were recorded at the beginning and end of the trial and average daily gain (ADG) was calculated by dividing total BW gain by the number of feeding days.

Data were analysed using ANCOVA (XLSTAT v2024.4) with batch as a fixed effect and initial BW and age as covariates.

Calves receiving RPBV gained 56±34.7 g/d more than controls (ADG: 1,099 g vs. 1,043 g/day, respectively), and the RPBV group showed higher ADG in every batch. Within the control group, 2 calves were culled (bloat, coccidiosis), but no calves were culled in the RPBV group.

In conclusion, adding RPBV to the diet of female growing dairy calves improved post-weaning performance and supported better health during this stressful developmental stage.

Keywords: rumen-protected B vitamins, dairy calves, post-weaning

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EFFECT OF A NATURAL FEED SUPPLEMENT CONTAINING INULIN AND NATURAL ANTI-INFLAMMATORY SUBSTANCES ON ANTIOXIDANT PARAMETERS AND MILK PRODUCTION OF DAIRY COWS

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The authors examined the effect of a natural feed supplement in dairy cows in the periparturient period. 200 g of supplement – containing organic acids (formic acid, acetic acid, butyric acid, benzoic acid), medium-chain fatty acids (8, 10 and 12 carbon atoms), betaine, inulin, methionine, oregano and garlic extract – was added to the total mixed ration of the treated cows in the prepartum period. 60 cows (30 cow pairs) were involved in the analysis. Blood samples were taken from the abdominal vein in the periparturient period 7 times. Glutathione-peroxidase activity, malondialdehyde and triglyceride concentrations were measured. In the early postpartum period glutathione-peroxidase activity and malondialdehyde concentration were enhanced. Although the increase in enzyme activity was less pronounced in the control than in the treated group, no significant difference was observed. Milk yield during the first 100 days of lactation was also compared. In the case of calvings when the first third of the lactation period coincided with the heat stress of summer, the milk production of cows in the treated group during the first 100 days was demonstrably higher than that of their paired counterparts in the control group.

Keywords: dairy cow, periparturient, antioxidant status, natural supplements