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PROTEIN SECURITY IN ANIMAL HUSBANDRY: CHALLENGES OF WAR AND SOLUTIONS

БІЛКОВА БЕЗПЕКА У ТВАРИННИЦТВІ: ВИКЛИКИ ВІЙНИ ТА ШЛЯХИ ЇЇ ВИРІШЕННЯ

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Abstract. The article presents a comprehensive scientific and practical analysis of ensuring protein security for farm animals in Ukraine under wartime conditions and during the period of post-war recovery. The material is based on a broad synthesis of contemporary scientific and practical research. It examines the destruction of infrastructure, shortages of soybean meal, logistical instability, as well as opportunities to use high-protein domestic components, alternative protein sources (insects, microbial and yeast proteins), low-crude-protein feeding strategies, enzyme technologies and enhanced biosafety. The importance of the One Health approach and diversification of agricultural crops is emphasized. A model of sustainable protein provision for livestock during war and reconstruction is proposed.

Keywords: protein security, amino acid nutrition, low-protein diets, SID, enzyme complexes, SunPro-46, insects, microbial protein, biosafety, One Health, resilience, feed resources.



Introduction

The full-scale war in Ukraine has led to the destruction of agricultural infrastructure, disruption of logistics chains, shortages of soybean meal and reduced stability of feed production [11–14]. Before the war, Ukraine was one of the world's leading exporters of sunflower meal – to 4–5 million tonnes annually [12], ensuring a stable raw material base for livestock production. The war resulted in the loss of processing capacities and port logistics [13], critically affecting the availability of protein feed ingredients. Additional challenges emerged due to epizootic risks caused by the destruction of sanitary barriers, evacuation of personnel and disruption of biosecurity protocols [15–16]. Under these circumstances, the need for adaptive feeding strategies, strengthened biosafety and reduced dependence on imported protein sources has intensified, corresponding to modern «One Health» principles [17].

Problems of Protein Supply in Animal Husbandry Under Wartime Conditions

The war has fundamentally altered the structure of protein provision, limiting access to traditional protein sources, especially soybean meal [11–14]. In this context, the importance of local high-protein resources, particularly sunflower-based products, has increased [12].

Sunflower meal SunPro®-46, containing up to 46% crude protein, has become a strategically important component capable of replacing a substantial portion of soybean protein [3]. Due to its elevated methionine content, it is effectively incorporated into SID-balanced diets [1–3].

Standardized ileal digestibility (SID) is a crucial tool for accurately calculating amino acid availability, especially amid the high variability of raw materials during the war [1–3,24]. This approach allows for optimizing amino acid composition, reducing nitrogen losses and improving feed conversion efficiency.

Rapeseed meal particularly fermented rapeseed meal – is another promising protein alternative. Studies indicate that fermentation reduces anti-nutritional factors, increases energy value and enables replacement of up to 12% of crude protein in the diet without compromising animal performance [4,27].



Several studies confirm the high nutritional value of plant protein ingredients – legumes, rapeseed, sunflower – when diets are properly balanced for amino acids [26]. This highlights the strategic role of Ukraine’s internal resource potential during wartime [14].

Low-protein diets enable a reduction in crude protein (CP) by 2–3% while maintaining animal productivity and reducing ammonia emissions by 25–35% [5–9,28–31]. This is essential when addressing economic, environmental and biosafety concerns simultaneously.

Zhu et al. [9] demonstrated that low-protein diets improve meat quality by enhancing lipid metabolism and muscle fiber morphology. Such effects help compensate for the shortage of high-protein ingredients without compromising product quality. A reduction in CP also decreases soybean meal dependency: lowering CP by just 2% saves 15–25 kg of soybean meal per tone of feed [5–7] – a critical factor during logistic disruptions.

Synthetic amino acids – lysine, methionine, threonine, valine – are essential for precise diet formulation under limited raw material availability [2–3,5]. According to EFSA, L-methionine produced by fermentation is safe and effective in feed applications [22]. SID-based diet design accounts for the true availability of amino acids from various sources – sunflower, rapeseed and legumes [24], which is vital under the fluctuating quality conditions of wartime.

Alternative protein sources are gaining increasing interest. Insect-based meals derived from *Hermetia illucens* and *Tenebrio molitor* demonstrate high amino acid bioavailability, antimicrobial properties and improved feed conversion when included at levels up to 10% [10,19,32]. Insect protein contains bioactive compounds that positively affect immune function, which is especially important under heightened epizootic risk.

Microbial and yeast proteins provide an important reserve for feed protein. They show high digestibility and contribute to immune resilience during stress – a critical need in wartime conditions [18,20]. Legume protein isolates (pea, lupin) exhibit high SID amino acid digestibility [7], making them valuable in diets substituting traditional



protein ingredients.

Enzyme complexes (xylanase, β -glucanase, protease, phytase) enhance nutrient digestibility and improve the efficiency of high-fiber ingredient utilization [8,35]. This enables broader use of domestic raw materials in feed formulation. Studies in food security emphasize the connection between stable protein provision and the resilience of the agricultural sector as a whole [13–14].

In wartime, biosafety becomes a primary factor of production stability: violation of biosecurity protocols leads to disease outbreaks and livestock losses [15–16]. A comprehensive biosecurity system is a mandatory element of protein resilience.

The «One Health» approach integrates veterinary science, ecology and food security, forming a systemic framework for protecting the livestock sector. Crop diversification has been shown to increase the stability of feed systems [21], which is particularly important in Ukraine with its growing share of legumes and rapeseed. Accurate biochemical and amino acid models, described in [25,33,34], help compensate for raw material shortages and maintain stable animal performance.

European Green Deal standards encourage reducing emissions, increasing protein-use efficiency and promoting environmentally friendly feeding systems. Integrating these technological approaches – alternative proteins, SID modeling, enzyme complexes and biosafety – creates a foundation for a sustainable protein system capable of withstanding wartime challenges.

Conclusion

Ukraine possesses substantial potential to develop a resilient and self-sufficient protein supply system. A comprehensive strategic model should integrate the use of high-protein domestic feed ingredients such as SunPro®-46, the incorporation of fermented rapeseed meal, and the implementation of low-protein diets with precisely balanced amino acid profiles to improve nitrogen utilization efficiency. Additional priority directions include the integration of alternative protein sources – such as insect, microbial and yeast proteins – the application of tailored enzyme complexes to enhance nutrient digestibility, the reinforcement of biosafety measures within the One Health framework, and the diversification of agricultural crop structure to stabilize raw



material availability. Collectively, these measures form a scientifically grounded, multi-component approach that strengthens protein resilience, mitigates wartime supply-chain disruptions and establishes a foundation for sustainable post-war recovery of the livestock sector.

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