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BIOCHEMICAL DIAGNOSIS OF LIVER DISEASES IN COWS

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Annotation: *This material presents the main changes in blood biochemical parameters observed in high-yield dairy cattle suffering from various forms of hepatopathy. Depending on the nature and severity of the pathological process, four characteristic biochemical profiles are distinguished, each reflecting a specific syndrome: hepatocellular insufficiency, inflammatory response, cholestatic disorder (excretory–biliary syndrome), and hepatocyte membrane damage syndrome.*

Analysis and dynamic monitoring of changes in biochemical parameters and contextual profiles allow us to understand pathological processes, metabolic and behavioral alterations, as well as acute and chronic functional disorders. This approach ensures more accurate diagnostics and serves as a basis for evaluating the effectiveness of therapeutic measures and predicting future health status.

Keywords: *diagnosis of liver diseases, hepatocellular insufficiency, inflammatory syndrome, transaminases, veterinary biochemistry*

Introduction: Early and accurate diagnosis of liver diseases in animals is one of the essential aspects of veterinary medicine, as treatment outcomes, productivity, and overall health largely depend on the adequate assessment of the functional state of this organ. The liver performs multiple vital functions: it participates in metabolic processes, intermediate metabolism, biosynthesis, and detoxification; regulates carbohydrate, protein, and lipid metabolism; synthesizes enzymes, hormones, and other biologically active substances. In the early stages,

liver dysfunction may not exhibit clear clinical signs, which significantly complicates accurate diagnosis [1,5].

Despite significant advances in medicine where efficient diagnostic schemes including imaging methods and extensive laboratory testing have long been implemented, veterinary practice, especially in the context of productive livestock, still lacks a universal approach to hepatopathy assessment. Comprehensive diagnostics are complicated by the absence of a single highly sensitive and specific test, as well as the lack of standardized guidelines adapted for interpreting biochemical and clinical data. Unlike human medicine, where clearly established syndromological approaches exist, veterinary medicine is still in the developmental stage of creating analogous diagnostic algorithms. A wide range of chemical substances enzymes, proteins, carbohydrates, lipids, pigments, low-molecular nitrogen compounds, hormones, and electrolytes are constantly present in the organism and circulating in the blood. These substances are maintained at stable levels, and any deviation from the norm may serve as an important indicator of pathological processes. Biochemical blood testing is particularly valuable for monitoring liver function, as it enables early detection of diseases even when clinical signs are absent [2–4]. However, conducting an extensive spectrum of biochemical tests is not always practical both from an economic standpoint and considering the physiological condition of the animal. More precisely, it is crucial to form an optimal biochemical panel a so-called biochemical profile and to identify the most informative syndrome-specific patterns. This allows diagnostics to be faster, more cost-effective, and result-oriented. With this in mind, our research aimed to develop methodological approaches for intravital diagnosis of liver diseases in cattle. Our focus was directed toward evaluating changes in the biochemical profile of blood to identify the most convenient and informative diagnostic methods for the organism.

Materials and Methods: The study was conducted on pregnant cows and heifers in the 7th–9th months of gestation, as well as lactating animals at various stages of the lactation cycle. Special attention was paid to the autumn–winter–spring period the time when the body experiences the highest homeostatic load. During

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clinical examination, signs indicating hepatic and metabolic dysfunction were recorded: reduced appetite, muscle weakness and wasting, ruminal hypotonia, enlargement of the liver border upon percussion, pain on palpation, nausea, vomiting, constipation, and bone demineralization. In some cases, brittle and dull hair coats were observed.

Blood samples were collected for biochemical analysis and evaluation of 15 parameters relevant to hepatic function and livestock health. These included: total protein, protein fractions, urea, glucose, enzymes (ALT, AST, GGT, ALP), cholesterol, triglycerides, total bilirubin, and the thymol turbidity test.

Results and Discussion: Analysis of the obtained data revealed significant deviations from physiological norms. Most cows (approximately 70%) and all heifers exhibited impaired protein metabolism, expressed as both decreased and increased total protein levels. Two main types of proteinograms were identified in the serum spectrum. The first type of hypoproteinemia occurred with normal albumin and gamma-globulin levels. During comprehensive biochemical testing, 10% of the examined cattle displayed changes characteristic of cholestatic syndrome. This condition is associated with impaired bile secretion and flow from hepatocytes, leading to the development of specific biochemical abnormalities. Blood analysis showed a typical pattern of changes indicating intrahepatic cholestasis. Among protein metabolism indicators, moderate hypergammaglobulinemia was observed: γ-globulin levels exceeded physiological norms by 13.7–17.8%. This reflects compensatory activation of the immune system, often linked to prolonged inflammation or bile stasis. Additionally, significant disturbances in lipid metabolism were detected total cholesterol levels increased 1.52–1.84 times above the upper physiological limit, indicating impaired emulsification and absorption of fats due to inadequate bile flow to the intestine.

Pigment metabolism indicators showed marked hyperbilirubinemia. Total bilirubin levels were 2–2.8 times higher than normal. This suggests impaired bilirubin excretion into bile, possibly due to damage to the bile ducts or compression of intrahepatic bile channels. Changes in enzyme activity also deserve particular

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attention. Alkaline phosphatase (ALP) and gamma-glutamyl transferase (GGT) activity increased markedly, while transaminases aspartate aminotransferase (AST) and alanine aminotransferase (ALT) remained within normal limits or showed mild elevation. This is characteristic of cholestasis: ALP and GGT are localized in the biliary epithelium and liver parenchyma, and their activity rises in response to mechanical or inflammatory damage to these structures. Thus, these enzymes are the most sensitive laboratory indicators of cholestatic processes in the hepatobiliary system. In some cases, slight increases in AST and ALT were detected, which may be associated with increased permeability of hepatocyte membranes, particularly in subclinical liver damage without acute inflammation. Such hyperenzymemia is usually short-lived and may not be detected outside of exacerbation phases. In several blood samples, elevations in AST, ALT, and bilirubin (1.58–2.75 times) were observed without signs of inflammation γ-globulin levels remained within normal limits, and the thymol test was negative. This indicates non-inflammatory but toxic liver injury. Possible causes include exogenous and endogenous toxins: mycotoxins, poor-quality feed, nitrates, urea, as well as insufficiently oxidized metabolic products such as ketone bodies, acetone, acetoacetic acid, etc. The conducted research made it possible to categorize hepatopathologies in high-yield dairy cattle into four biochemical profiles, each reflecting a specific pathological process in the liver.

Conclusion: Thus, monitoring the dynamics of these biochemical profiles enables an objective assessment of the nature and severity of pathological processes in the liver of cattle. This approach allows early diagnosis of hepatopathies, effective monitoring of therapeutic interventions, and reliable prognosis of hepatobiliary diseases, which is particularly important under intensive livestock production conditions.

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