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The role of the intestinal microbiome and parasitic infections in the response to diabetes mellitus treatment in companion animals.

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Abstract: *Diabetes mellitus in companion animals is a complex metabolic disorder increasingly linked to alterations in the gut microbiome and the immunomodulatory effects of parasitic infections, with bidirectional interactions influencing metabolic regulation and disease progression.Dysbiosis promotes insulin resistance and inflammation, while certain parasites, especially helminths, may have protective effects, highlighting new opportunities for microbiome-based and personalized therapeutic strategies.*

Keywords: *diabetes mellitus; gut microbiome; parasitic infections.*

Introduction:

- Diabetes mellitus in companion animals is strongly influenced by intestinal microbiome alterations, where dysbiosis promotes insulin resistance, inflammation, and metabolic dysfunction.
- Parasitic infections, especially helminths, can modulate immune and metabolic responses, potentially reducing inflammation and affecting glucose homeostasis.
- The interaction between gut microbiota and parasites represents a key regulatory axis with implications for diabetes pathogenesis and future therapeutic strategies.

Materials and Methods:

This narrative review synthesizes existing literature on the role of the gut microbiome and parasitic infections in modulating diabetes mellitus and treatment response in companion animals through a qualitative analysis of published studies, without performing a meta-analysis.

Results and Discussions

1. Alterations of the Intestinal Microbiome in Diabetes Mellitus

- Diabetes in dogs and cats is associated with significant gut microbiome alterations (dysbiosis), which affect metabolism, inflammation, and glycemic regulation, and may also influence therapeutic response.

Category	Observed changes
Microbial diversity	Reduced diversity in diabetic animals
Taxonomic shifts	Altered abundance of carbohydrate- and lipid-metabolizing bacteria
Metabolic function	Impaired microbial metabolic potential (SCFA production, glucose metabolism)
Dysbiosis drivers	Diet, environment, host physiology
Immune-metabolic link	Chronic inflammation and insulin resistance
Therapeutic modulation	Probiotics, diet, drugs alter microbiome composition

Table 1. Alterations of gut microbiome in diabetic companion animals.

2. Intestinal Dysbiosis and Treatment Response

- Dysbiosis contributes to variability in treatment response by affecting metabolism and immunity, while therapies (drugs, diet, probiotics) can also modify the microbiome, supporting personalized treatment approaches.

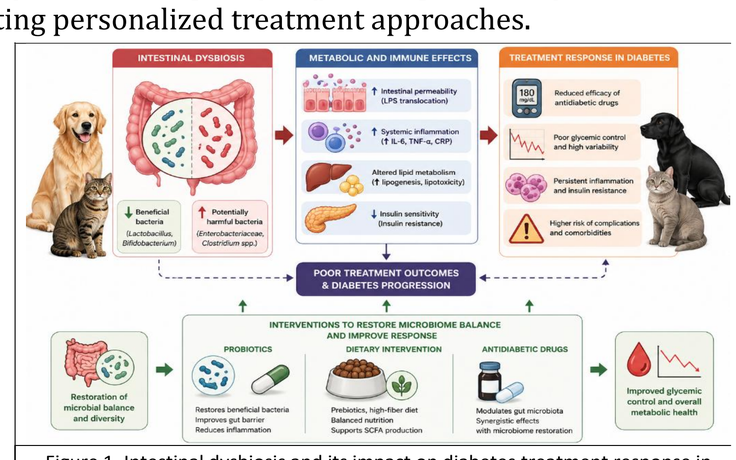

Figure 1. Intestinal dysbiosis and its impact on diabetes treatment response in companion animals.

3. Microbiome–Immune System Interaction

- The gut microbiome regulates immune responses and inflammation, contributing to insulin resistance and β-cell dysfunction, with additional interactions involving metabolic pathways such as the endocannabinoid system.

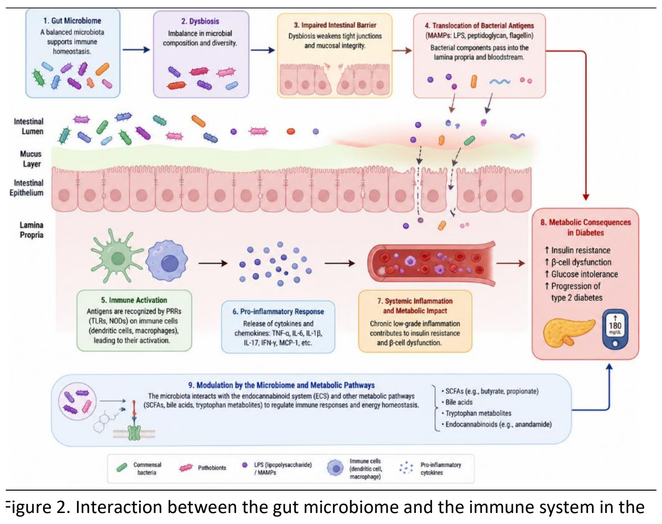

Figure 2. Interaction between the gut microbiome and the immune system in the pathogenesis of diabetes

4.Role of Parasitic Infections in Glucose Metabolism

- Helminth infections can modulate immune responses and reduce inflammation, potentially improving insulin sensitivity and influencing glucose metabolism through microbiota and metabolic pathways.

5. Microbiome–Parasite Interaction

- There is a bidirectional interaction between parasites and the gut microbiome, which influences immune balance, inflammation, and metabolic regulation, with potential therapeutic implications.

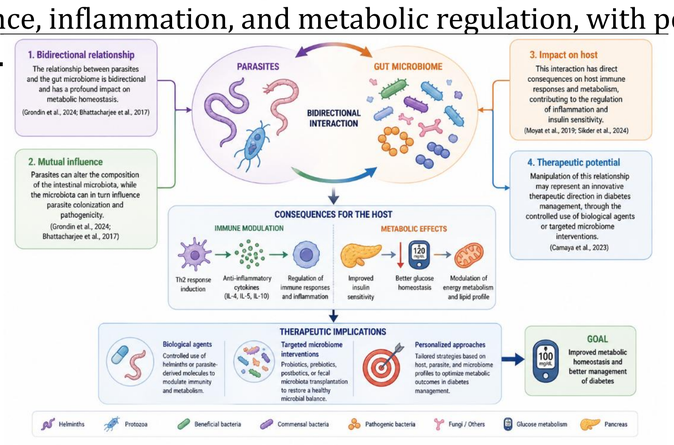

Figure3.Microbiome-Parasite interaction and metabolic implications.

6. Clinical Evidence and Associated Pathologies

- Diabetes in veterinary medicine is frequently associated with comorbid conditions (especially hepatic disease and oxidative stress), which complicate metabolic control and treatment outcomes.

7. Epidemiological and Clinical Role of Parasites

- Parasitic infections may indirectly affect metabolism through systemic inflammation and immune alterations, contributing to metabolic stress and disease complexity.

8.Therapeutic Perspectives and Future Directions

- Future management of diabetes may include microbiome modulation (probiotics, diet) and immunomodulatory approaches targeting parasite–host interactions, leading to more integrated therapies.

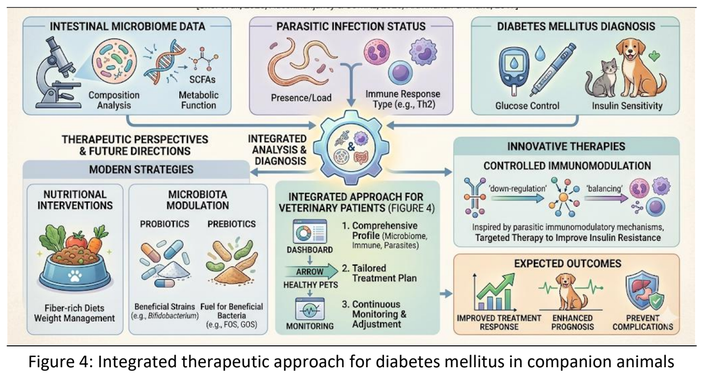

Figure 4: Integrated therapeutic approach for diabetes mellitus in companion animals through microbiome modulation and immunomodulation.

Conclusions:

Diabetes mellitus in companion animals is a multifactorial disease influenced by microbiome–immune interactions, where dysbiosis and parasitic modulation impact metabolism, highlighting the potential of integrated, personalized therapeutic strategies.

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