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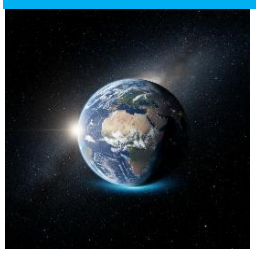

Quality in Sport. eISSN 2450-3118.

Journal Home Page
https://apcz.umk.pl/QS/index

MICHALAK, Karolina, FAHIM, Knieszko, FRANASZEK, Jakub, HERCHI, Nadia, JABRZYK, Martyna, JARCZYŃSKA, Patrycja, KIJOWSKI, Wojciech, KLUSEK, Mateusz and PRZYBYŁ, Maciej. Sodium Butyrate Supplementation: Current Evidence, Clinical Indications, and Limitations. Quality in Sport. 2026;54:70348. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.54.70348

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 28.03.2026. Revised: 30.03.2026. Accepted: 30.03.2026. Published: 05.04.2026.

Sodium Butyrate Supplementation: Current Evidence, Clinical Indications, and Limitations

Karolina Michalak
Karol Marcinkowski University Hospital in Zielona Góra, Zyty 26, 65-046 Zielona Góra, Poland
https://orcid.org/0009-0004-2572-976X
michalak.karola@gmail.com
Knieszko Fahim
Jan Mikulicz-Radecki University Clinical Hospital in Wrocław, Borowska 213, 50-556 Wrocław, Poland
https://orcid.org/0009-0007-6320-5758
kniecho@gmail.com

Jakub Franaszek
Independent Public Health Care Centre in Kozienice, Aleja Władysława Sikorskiego 10, 26-900 Kozienice, Poland
https://orcid.org/0009-0007-0631-9046
franaszekjakub@gmail.com
Nadia Herchi
Provincial Specialist Hospital in Wrocław, Henryka Michała Kamieńskiego 73a, 51-124 Wrocław - Karłowice, Poland
https://orcid.org/0009-0007-9952-7222
nadia.herchi@gmail.com
Martyna Jabrzyk
Military Medical Academy Memorial Teaching Hospital of the Medical University of Lodz - Central Veteran Hospital, Żeromskiego 113, 90-549 Łódź, Poland
https://orcid.org/0009-0007-7961-4986
martynajabrzyk@gmail.com
Patrycja Jarczyńska
4th Military Clinical Hospital with Polyclinic SPZOZ in Wrocław 50-981 Wrocław, Rudolfa Weigla 5, Poland
https://orcid.org/0009-0006-7249-8276
jarczynska.p@gmail.com
Wojciech Kijowski
Karol Marcinkowski University Hospital in Zielona Góra, Zyty 26, 65-046 Zielona Góra, Poland
https://orcid.org/0009-0006-6527-9200
kijowskiwojciech@gmail.com
Mateusz Klusek
Ryszard Rzepka Hospital, Zwycięstwa Street 1, 66-100 Sulechów
https://orcid.org/0009-0009-0354-1527
matyklusek@gmail.com
Maciej Przybył
Military Medical Academy Memorial Teaching Hospital of the Medical University of Lodz - Central Veteran Hospital, Żeromskiego 113, 90-549 Łódź, Poland
https://orcid.org/0009-0006-1432-119X
maciejdominikprzybyl@gmail.com
Corresponding author:
Karolina Michalak
Karol Marcinkowski University Hospital in Zielona Góra, Zyty 26, 65-046 Zielona Góra, Poland
https://orcid.org/0009-0004-2572-976X
michalak.karola@gmail.com

Abstract

Introduction and purpose: Butyrate is one of the most important short-chain fatty acids produced by the gut microbiota through fermentation of undigested dietary components, especially dietary fiber. It plays a key role in intestinal homeostasis by supporting colonocyte metabolism, maintaining epithelial barrier integrity, and modulating immune responses. The aim of this paper was to review current evidence on sodium butyrate supplementation, with

particular attention to its mechanisms of action, clinical indications, and limitations of the available evidence.
A brief description of the state of knowledge: Experimental studies suggest that butyrate exerts anti-inflammatory, immunomodulatory, and barrier-protective effects. Its mechanisms include histone deacetylase inhibition, signaling through short-chain fatty acid-sensitive G protein-coupled receptors, and modulation of pathways related to NF-κB activation. Clinical findings are most promising in ulcerative colitis, especially with microencapsulated formulations. In irritable bowel syndrome, metabolic disorders, and pediatric inflammatory bowel disease, the results remain limited or inconsistent.
Summary: Sodium butyrate supplementation appears to be a promising supportive strategy in selected clinical settings, but current evidence does not justify its use as a universally effective intervention. Further well-designed clinical trials are needed to identify optimal indications, dosing regimens, and patient groups most likely to benefit.
Keywords: sodium butyrate; butyrate; gut microbiota; inflammatory bowel disease; irritable bowel syndrome; metabolic disorders

Introduction

The gut microbiota is an integral component of human physiology and constitutes the largest and most diverse community of microorganisms inhabiting the human body. It plays a key role in maintaining homeostasis by participating in numerous physiological processes, including nutrient metabolism, regulation of immune responses, and maintenance of intestinal barrier integrity [1–3]. Disturbances in the composition and function of the microbiota, referred to as dysbiosis, are increasingly associated with the development of many chronic diseases, including inflammatory bowel disease, metabolic disorders, and certain neuropsychiatric conditions [2–4].
One of the key mechanisms through which the gut microbiota influences the host is the production of metabolites generated during the fermentation of undigested dietary components, particularly dietary fiber [1,2,5]. Among the most important of these are short-chain fatty acids (SCFAs), such as acetate, propionate, and butyrate [1,2,5]. These compounds are produced mainly in the large intestine through bacterial fermentation of polysaccharides and play an important role in communication between the microbiota and the host, influencing both local metabolism and systemic processes [4–6].
Among short-chain fatty acids, butyrate is of particular importance because of its role in maintaining proper intestinal barrier function. A substantial proportion of butyrate produced in the gut is utilized locally by colonic epithelial cells as their primary energy substrate [7,8]. In addition, butyrate has been shown to affect the proliferation and differentiation of intestinal epithelial cells, strengthen tight junctions between epithelial cells, and modulate the activity of immune cells, thereby contributing to the reduction of inflammatory processes within the gastrointestinal tract [7–9]. A small proportion of butyrate produced in the intestine reaches the systemic circulation, where it may indirectly affect the function and metabolism of peripheral tissues through effects on gut hormone secretion, metabolic pathways, and gut–brain axis signaling [4,6,10].
The biological mechanisms of butyrate action are multifaceted. One of the most important is its ability to inhibit histone deacetylases (HDACs), leading to epigenetic changes that affect the expression of genes involved in inflammation, cell proliferation, and the differentiation of immune cells [8–10]. In addition, butyrate acts through G protein-coupled receptors responsive to short-chain fatty acids, such as GPR41, GPR43, and GPR109A, which are involved in the regulation of immune responses and metabolic processes [9–11]. It also has the ability to modulate inflammatory responses by affecting key signaling pathways related to the activation

of nuclear factor kappa B (NF-κB), which further strengthens the biological rationale for its potential use in diseases associated with chronic inflammation [8–10]. Through these mechanisms, butyrate is considered to play an important role in maintaining intestinal homeostasis and modulating inflammatory processes within the body.

In recent years, increasing attention has been paid to the potential therapeutic use of butyrate, particularly in the form of sodium butyrate. Experimental studies and literature reviews suggest that this compound may exert beneficial effects on intestinal barrier integrity, microbiota composition, and the regulation of inflammatory processes. These effects may be relevant to the pathogenesis of inflammatory bowel disease, metabolic disorders, and other conditions associated with chronic inflammation [8,12,13].

Despite its promising biological basis and numerous experimental studies, the effectiveness of sodium butyrate supplementation in humans remains a matter of debate. Although available data indicate potential benefits of this intervention, the results of clinical studies are inconclusive, and the number of high-quality studies remains limited [12,13]. The need for further research to determine optimal doses, duration of administration, and patient groups most likely to benefit from such an intervention has also been emphasized [12,13].

In view of the above, there is a need for a critical analysis of the available evidence regarding sodium butyrate supplementation. The aim of this paper is to review the current literature on the potential benefits and limitations of sodium butyrate supplementation and to identify patient populations in whom this intervention may provide clinical benefit, as well as those in whom its effectiveness remains unconfirmed.

Physiological role of butyrate

Butyrate is one of the most important short-chain fatty acids produced in the large intestine through bacterial fermentation of undigested dietary components, particularly dietary fiber. The main butyrate-producing bacteria include members of the phylum Firmicutes, especially *Faecalibacterium prausnitzii*, *Eubacterium rectale*, and species of the genus *Roseburia*. Butyrate is produced mainly from undigested polysaccharides, such as resistant starch and other fiber fractions, but it may also result from the secondary utilization of metabolites such as acetate and lactate. Therefore, the amount of butyrate produced depends on both the composition of the microbiota and the quality of the diet, particularly fiber intake and the availability of fermentable substrates [5,14,15].

Butyrate is absorbed primarily in the large intestine by colonic epithelial cells, with MCT1 and SMCT1 serving as the main transporters involved in this process. Most absorbed butyrate is then metabolized locally in colonocytes, whereas only a small proportion enters the portal circulation and subsequently the systemic circulation. This pattern of transport and metabolism explains why the physiological effects of butyrate are predominantly local [16,17].

From a physiological perspective, butyrate is the main energy substrate for colonocytes. A substantial proportion of the butyrate produced in the intestine is utilized locally by colonic epithelial cells for energy production, which supports their normal metabolism, survival, and regenerative capacity. As a result, butyrate plays an important role in maintaining proper epithelial renewal, cellular differentiation, and mucosal homeostasis in the large intestine [7,8,18].

One of the most important aspects of the physiological role of butyrate is its effect on intestinal barrier integrity. It has been shown to promote the proper organization and expression of tight junction proteins, enhance epithelial barrier integrity, and reduce intestinal permeability. As a result, it may limit the translocation of bacteria and their components into the systemic circulation, which is important for maintaining inflammatory homeostasis [9,19,20].

In summary, butyrate is one of the key mediators linking diet, the microbiota, and host physiology. Its role includes the regulation of colonocyte metabolism, support for epithelial regeneration, maintenance of intestinal barrier integrity, and modulation of local immune responses. The physiological significance of butyrate therefore provides a biological basis for considering its potential therapeutic use [6,8,18].

Biological mechanisms of action of sodium butyrate

The biological mechanisms of action of sodium butyrate are multifaceted and include both processes occurring at the molecular level and effects related to intestinal barrier function and regulation of immune responses. One of the best characterized mechanisms of its action is the inhibition of histone deacetylases (HDACs), which leads to changes in histone acetylation and, consequently, to modulation of gene expression involved in inflammatory processes, cell proliferation, and immune cell differentiation. This mechanism is considered one of the main molecular explanations for the anti-inflammatory effects of butyrate [8–10].

Butyrate also acts through G protein-coupled receptors responsive to short-chain fatty acids, such as GPR41, GPR43, and GPR109A. Activation of these receptors affects signaling pathways related to immune responses, maintenance of intestinal mucosal homeostasis, and regulation of selected metabolic pathways. As a result, butyrate functions not only as a bacterial metabolite but also as a signaling molecule involved in communication between the microbiota and the host [9–11].

Another important component of the anti-inflammatory action of butyrate is its effect on the IκB/NF-κB pathway, which plays a key role in regulating the expression of genes involved in the inflammatory response of the intestinal mucosa. Experimental studies have shown that butyrate may reduce the expression of pro-inflammatory cytokines by inhibiting NF-κB activation and stabilizing IκBα, which provides an important biological rationale for its potential use in inflammatory bowel disease [21,22]. This pathway is considered one of the major regulators of the balance between inflammation and mucosal protection; therefore, its modulation may affect both the intensity of immune responses and reparative processes within the intestinal epithelium [22]. In this context, the immunomodulatory effects of sodium butyrate include not only its influence on intracellular signaling pathways but also its regulation of immune cell activity within the intestinal mucosa. This compound modulates cytokine production and affects the balance between pro-inflammatory and anti-inflammatory mechanisms. As a result, it may promote the maintenance of immune tolerance and reduce chronic inflammatory activation within the gastrointestinal tract [9,10,21].

At the cellular level, sodium butyrate also affects the expression of proteins responsible for maintaining intestinal barrier integrity, including tight junction proteins. In addition, it influences pathways regulating epithelial cell differentiation, survival, and renewal, thereby supporting the proper organization of the intestinal epithelium. Preclinical data also indicate that topical administration of sodium butyrate may increase the expression of trefoil factor 3 (TFF3) and decrease the expression of IL-1β and NF-κB, which may support mucosal repair processes and reduce inflammatory damage [23]. Consequently, butyrate may limit increased intestinal permeability and reduce the translocation of bacteria and their components into the systemic circulation [8,9,19,20].

Although most of butyrate's activity is localized to the gastrointestinal tract, a small amount that reaches the circulation may indirectly affect metabolic processes and signaling between the intestine and other organs. It has been suggested that butyrate may influence pathways related to energy metabolism, gut hormone secretion, and communication along the gut–brain axis; however, the significance of these effects in clinical practice remains incompletely understood [6,10].

The multifaceted nature of sodium butyrate action provides a biological basis for considering its potential therapeutic use. However, it should be emphasized that well-documented molecular mechanisms do not always translate directly into a clear clinical effect. For this reason, the assessment of sodium butyrate supplementation should take into account both the underlying biological rationale and the limitations of the available clinical studies [8,10,12,13].

Sodium butyrate supplementation in inflammatory bowel disease

Interest in sodium butyrate supplementation in inflammatory bowel disease stems from its well-documented biological properties. Current reviews indicate that butyrate may be considered primarily as a potential adjunctive therapy; however, the available clinical evidence remains limited, and its interpretation is complicated by differences in study design, formulation, and assessed endpoints. A systematic review published in 2024 emphasized that, despite a promising biological rationale, the number of studies of high methodological quality remains limited [24].

The formulation of sodium butyrate is of particular clinical importance because unprotected forms of this compound are rapidly absorbed in the upper gastrointestinal tract. Microencapsulated sodium butyrate was developed to increase delivery of the active substance to the large intestine, where its local effects may be of greatest therapeutic importance [25].

The most promising clinical data concern ulcerative colitis. In a multicenter, randomized, double-blind, placebo-controlled study published in 2025, the efficacy of microencapsulated sodium butyrate as adjunctive therapy was evaluated in 98 adult patients with active mild-to-moderate ulcerative colitis. Patients received 300 mg of the preparation twice daily or placebo for 8 weeks. The authors demonstrated that this intervention was safe and was associated with a higher frequency of clinical improvement, a higher rate of clinical remission, more frequent biochemical remission, and more frequent endoscopic improvement than placebo. In addition, the therapeutic effects were accompanied by an increase in fecal butyrate (C4) concentration, which was positively correlated with improvement in clinical, biochemical, and endoscopic parameters. These findings may suggest an association between increased fecal butyrate levels and a favorable treatment response. However, it should be emphasized that the study included a relatively short 8-week follow-up period, which limits assessment of the long-term effects of therapy. The authors also highlighted the need for further studies evaluating the effects of longer-term use of microencapsulated sodium butyrate, especially with regard to mucosal healing. At present, this study represents one of the strongest clinical arguments supporting the potential usefulness of sodium butyrate in selected cases of ulcerative colitis [25].

Additional support for this observation is provided by a randomized, placebo-controlled study published in 2025, which evaluated the effects of sodium butyrate supplementation in patients with active ulcerative colitis. The authors reported reduced disease activity, improvement in selected inflammatory markers, and beneficial effects on certain psychological parameters and sleep quality. These results are noteworthy and strengthen the hypothesis that sodium butyrate may have value as an adjunctive therapy; however, they should be interpreted with caution because of the smaller scale of the study compared with large multicenter trials [26].

The evidence is much weaker with regard to Crohn’s disease. Current reviews indicate that data concerning this condition remain limited and do not allow firm conclusions to be drawn regarding the effectiveness of oral sodium butyrate supplementation. In practical terms, this means that although there is a mechanistic rationale for the use of butyrate in Crohn’s disease, robust clinical studies allowing reliable assessment of its effectiveness in this population are still lacking [12,24].

Data concerning the pediatric population are particularly important when assessing evidence quality, as they show clear inconsistency in results. In a randomized, placebo-controlled,

multicenter study published in 2022, 12-week sodium butyrate supplementation as adjunctive treatment in children and adolescents with newly diagnosed inflammatory bowel disease (IBD) did not show superiority over placebo. This finding represents an important counterargument against overly broad conclusions regarding the effectiveness of supplementation [27].
At the same time, a more recent publication from 2025 involving the pediatric IBD population reported more favorable results, suggesting that sodium butyrate supplementation may be effective as adjunctive treatment in children and adolescents with newly diagnosed disease. However, the discrepancy between these two studies indicates that the current state of knowledge still does not allow unequivocal recommendations for the pediatric population and underscores the need for further well-designed studies [28].
In summary, current clinical data suggest that sodium butyrate may have the greatest potential as an adjunctive therapy in selected adult patients with ulcerative colitis, particularly with controlled-release formulations. At the same time, for the entire spectrum of IBD, and especially for Crohn's disease and the pediatric population, the available evidence remains insufficient or inconsistent. Therefore, sodium butyrate supplementation cannot currently be regarded as an intervention with confirmed, universal efficacy in inflammatory bowel disease [12,24].

Sodium butyrate supplementation in irritable bowel syndrome and functional gastrointestinal disorders

Irritable bowel syndrome (IBS) is one of the most common functional gastrointestinal disorders, and its pathogenesis is multifactorial. Contributing factors include disturbances in the gut–brain axis, increased intestinal permeability, neuroimmune interactions, and changes in the composition and activity of the gut microbiota. In this context, butyrate, a bacterial metabolite with anti-inflammatory and immunomodulatory properties that also supports intestinal barrier integrity, is considered a potential factor that may alleviate selected symptoms of irritable bowel syndrome [29].
Available clinical studies suggest that sodium butyrate supplementation may be beneficial in a subset of patients with IBS; however, the results are not entirely consistent.
In a randomized, placebo-controlled study published in 2013 and involving 66 patients with IBS, microencapsulated sodium butyrate used as an adjunct to standard pharmacotherapy was associated with a significant reduction in the frequency of selected symptoms. After 4 weeks, a significant reduction in the frequency of abdominal pain during defecation was observed, whereas after 12 weeks there was also a significant reduction in the frequency of spontaneous abdominal pain, postprandial pain, pain during defecation, and post-defecation urgency, as well as improvement in constipation. At the same time, no statistically significant improvement was demonstrated in pain intensity, bloating, or defecation disorders, which suggests that the beneficial effect of supplementation may relate primarily to the frequency of selected symptoms rather than a full reduction in their severity [30].
More optimistic results were reported in a multicenter clinical study published in 2022, which evaluated the efficacy of a sodium butyrate preparation in a triglyceride matrix in 3000 non-hospitalized patients with IBS. After 12 weeks, significant improvement was observed in abdominal pain, bloating, diarrhea, constipation, urgency, nausea and vomiting, as well as in quality of life. However, it should be noted that this study did not include a placebo group, which substantially limits the possibility of unambiguous interpretation of the findings and does not allow the effects of supplementation to be distinguished from the natural variability of symptoms or from patients' expectations [31].
More recent data regarding combination therapies containing butyrate are also noteworthy. In a randomized, double-blind, placebo-controlled study published in 2024, a mixture of

microencapsulated sodium butyrate, probiotics, and short-chain fructooligosaccharides was evaluated in adult patients with IBS. In this study, a higher proportion of patients reported subjective relief of symptoms after 4 weeks, and after 12 weeks reduced severity of urgency and less frequent symptom worsening were observed. At the same time, no significant differences were found in symptom severity assessed using the IBS Severity Scoring System (IBS-SSS) or in quality of life assessed using the IBS Quality of Life (IBS-QOL) scale. Because the tested preparation also contained probiotics and a prebiotic, it is difficult to determine unequivocally what proportion of the observed effect was attributable exclusively to the presence of sodium butyrate [32].

Taken together, the available data suggest that sodium butyrate may alleviate selected symptoms of irritable bowel syndrome, particularly those related to defecation, urgency, and some pain-related symptoms. However, it is more difficult to draw clear conclusions regarding the effect of supplementation on the overall clinical picture of the disease and on patients' quality of life. It should also be remembered that the available studies differed in both the size and characteristics of the study populations, as well as in the design of the preparations and the way they were administered. For this reason, sodium butyrate should currently be regarded as a potential adjunctive therapy in selected patients with irritable bowel syndrome rather than as an intervention with confirmed, universal efficacy [30–32].

Sodium butyrate supplementation in metabolic disorders

In recent years, increasing attention has been paid to the possible role of sodium butyrate in metabolic disorders. Particular focus has been placed on its potential effects on selected metabolic parameters in patients with obesity, metabolic syndrome, type 2 diabetes, and metabolic dysfunction-associated steatotic liver disease (MASLD). Despite promising preclinical data, the number of interventional studies conducted in humans remains limited, and their results do not provide a consistent picture [33].

One of the more frequently cited clinical studies in this area is the study by Bouter et al., which evaluated the effects of oral supplementation with 4 g of sodium butyrate daily for 4 weeks in healthy lean men and men with metabolic syndrome. Improved peripheral and hepatic insulin sensitivity was observed only in the lean male group, whereas no significant metabolic benefits were demonstrated in participants with metabolic syndrome. This suggests that the response to supplementation may depend on the patient's baseline metabolic phenotype [34].

The results of the study by Cleophas et al. should be interpreted with similar caution. Healthy men and men with obesity and features of metabolic syndrome received 4 g of sodium butyrate daily for 4 weeks. The authors did not demonstrate a clear effect of supplementation on the assessed inflammatory markers; however, they observed changes in selected immunometabolic pathways in patients with metabolic syndrome. This suggests that the effects of sodium butyrate in this group may relate more to specific regulatory pathways than to overall clinical improvement [35].

Mixed findings have also been reported in studies conducted in patients with type 2 diabetes. In a randomized, double-blind, placebo-controlled study, Roshanravan et al. demonstrated an increase in glucagon-like peptide-1 levels after sodium butyrate supplementation alone and after combination therapy with inulin. At the same time, a significant reduction in fasting glucose and waist-to-hip ratio was observed primarily in the group receiving butyrate in combination with inulin, which may suggest greater effectiveness of this approach than the use of butyrate alone [36].

In another randomized, triple-blind, placebo-controlled study, Khosravi et al. evaluated the effects of sodium butyrate supplementation on glycemic control, lipid profile, blood pressure, and selected markers of oxidative stress in patients with type 2 diabetes. Significant reductions

in systolic and diastolic blood pressure as well as in 2-hour postprandial glucose were observed; however, no significant improvement was observed in many of the remaining parameters. These findings indicate that the potential metabolic benefits of sodium butyrate may be partial and may not extend to all assessed domains [37].

Data regarding MASLD are also noteworthy. In the interventional study by Mitrović et al., the primary endpoint, namely the change in the degree of hepatic steatosis assessed using controlled attenuation parameter (CAP), did not improve significantly. At the same time, a significant reduction in trimethylamine N-oxide concentration and the fatty liver index was observed in the group receiving sodium butyrate, whereas a decrease in fecal calprotectin concentration was found in the group receiving calcium butyrate. These findings suggest that supplementation may affect selected metabolic and inflammatory markers; however, its clinical significance in this condition remains uncertain [38].

The available studies do not currently allow firm conclusions regarding the effectiveness of sodium butyrate supplementation in metabolic disorders. Some findings suggest beneficial effects on selected metabolic, immunological, and inflammatory parameters; however, the nature and extent of the observed effects differed across studies and study populations. For this reason, sodium butyrate should currently be regarded as a potential supportive intervention rather than as a treatment with established clinical efficacy [33–38].

Discussion

A review of the available evidence shows that sodium butyrate supplementation has a strong biological rationale but much weaker and less conclusive clinical support. This distinction appears crucial for the proper interpretation of the current literature. On the one hand, butyrate plays a well-documented role in maintaining intestinal barrier integrity, regulating immune responses, and modulating inflammatory pathways. On the other hand, the results of interventional studies in humans are still not sufficiently consistent to regard sodium butyrate supplementation as an intervention with established and universal efficacy [8–10,12,13].

The most convincing data concern ulcerative colitis. In this group of patients, particularly when microencapsulated formulations are used, clinical, biochemical, and endoscopic improvement has been observed, which clearly distinguishes ulcerative colitis from the other conditions analyzed [25,26]. This does not mean, however, that the issue of efficacy has already been definitively resolved. Even the best-designed studies included relatively short follow-up periods, and the number of high-quality trials remains limited [24,25]. For this reason, sodium butyrate can currently be considered an adjunctive therapy rather than a full-fledged alternative to standard treatment.

The evidence regarding Crohn's disease remains much weaker. To date, clinical results in this group have not been as clear as those observed in ulcerative colitis [12,24]. This may be due to several factors. First, the two conditions differ in pathophysiology and in the location of inflammatory lesions. Second, the efficacy of butyrate may depend on whether the active substance actually reaches the site where its action is most relevant. In this context, the formulation becomes particularly important, especially the use of delayed-release or controlled-release forms [24,25].

Interpretation of data concerning the pediatric population also requires particular caution. The two most important studies conducted in children and adolescents with newly diagnosed inflammatory bowel disease yielded divergent results [27,28]. One of them showed no advantage of supplementation over placebo, whereas the other suggested a beneficial effect of adjunctive treatment. Such inconsistency does not currently allow unequivocal recommendations to be made. Rather, it suggests that the effects of supplementation may

depend on the characteristics of the studied population, study design, dose, duration of intervention, and selected endpoints.

A similar issue is evident in studies on irritable bowel syndrome. Some findings are encouraging, particularly with regard to the frequency of selected symptoms, such as pain associated with defecation, urgency, and certain pain-related symptoms [30,31]. It is much more difficult, however, to draw equally convincing conclusions regarding the overall clinical picture of the disease and quality of life [30–32]. An additional difficulty is that not all studies evaluated comparable preparations. Some assessed sodium butyrate alone, whereas others investigated combined formulations also containing probiotics and prebiotics [32]. This limits the ability to determine precisely to what extent the observed effects can be attributed to butyrate itself.

An inconclusive picture also emerges from studies on metabolic disorders. In this patient group, some studies indicate improvement in selected parameters, such as insulin sensitivity, postprandial glucose levels, blood pressure, or certain immunometabolic markers [34–37]. However, it is difficult to identify a consistent and reproducible effect. In the study by Bouter et al., improvement was observed in lean participants but not in individuals with metabolic syndrome [34]. In studies conducted in patients with type 2 diabetes, some benefits were more pronounced when inulin was administered concomitantly, which makes it difficult to assess the independent effect of sodium butyrate [36]. The study involving MASLD did not demonstrate improvement in the primary endpoint, despite some changes in selected secondary markers [38]. Altogether, this suggests that any metabolic benefits may be selective in nature and may depend on the patient's phenotype.

A common problem across most of the analyzed studies is their heterogeneity. This concerns nearly every element of study design: sample size, duration of follow-up, dose, formulation technology, target population, and choice of endpoints [24,30–38]. In practice, this means that comparing results across studies is difficult, even when they concern similar clinical indications. This, in turn, limits the possibility of drawing stronger and more generalizable conclusions.

It is also important that some of the favorable observations concerned mainly biochemical, immunological, or molecular markers rather than hard clinical endpoints. Such a discrepancy between the biological effect of an intervention and its practical significance for the patient is not uncommon in studies on supplementation and adjunctive therapies. In the case of sodium butyrate, this may mean that its action does indeed influence pathophysiological processes, but does not always translate into clear and clinically meaningful improvement.

At the current stage of knowledge, the most justified approach seems to be to regard sodium butyrate as a potential adjunctive intervention rather than as a treatment with confirmed efficacy in a broad patient population. The strongest arguments support its potential usefulness in selected adult patients with ulcerative colitis, especially when controlled-release formulations are used [25,26]. In the remaining indications, the available data are still too limited, too heterogeneous, or too preliminary to support stronger conclusions.

Future studies should focus primarily on better selection of target populations, standardization of formulations, longer follow-up periods, and the use of more comparable endpoints. It will also be important to determine whether there are specific clinical or metabolic profiles that predict a better response to supplementation. Only such data will make it possible to define more precisely the place of sodium butyrate in clinical practice.

Conclusions

Sodium butyrate supplementation has a strong biological rationale; however, its clinical efficacy has not yet been unequivocally confirmed across all analyzed indications. Current evidence suggests that its greatest clinical potential may be seen in selected adult patients with

ulcerative colitis, especially when microencapsulated or controlled-release formulations are used [24–26].
In irritable bowel syndrome and metabolic disorders, beneficial effects of supplementation have been observed with regard to selected symptoms and biological parameters; however, the results remain inconsistent and do not allow unequivocal recommendations to be made [30–38]. Particular caution is also required with regard to the pediatric population, in which the available studies have yielded divergent results [27,28].
The main limitations of the current evidence are the small number of high-quality studies, their considerable heterogeneity, and the short duration of follow-up. For this reason, sodium butyrate should currently be regarded primarily as a potential adjunctive therapy that requires further verification in well-designed clinical studies [12,24].

Supplementary materials:

Not applicable.

Author's contribution:

Conceptualization: Karolina Michalak, Wojciech Kijowski, Maciej Przybył; methodology: Karolina Michalak, Mateusz Klusek, Jakub Franaszek; software: Mateusz Klusek, Knieszko Fahim; validation: Wojciech Kijowski, Martyna Jabrzyk, Patrycja Jarczyńska; formal analysis: Knieszko Fahim, Maciej Przybył; investigation: Nadia Herchi, Martyna Jabrzyk; resources: Jakub Franaszek, Patrycja Jarczyńska; data curation: Nadia Herchi, Patrycja Jarczyńska; writing – original draft preparation: Karolina Michalak, Jakub Franaszek; writing – review and editing: Karolina Michalak, Maciej Przybył; visualization: Mateusz Klusek; supervision: Karolina Michalak, Wojciech Kijowski; project administration: Karolina Michalak.

Funding Statement:

This research received no external funding.

Institutional Review Board Statement:

Not applicable.

Informed Consent Statement:

Not applicable.

Acknowledgements:

Not applicable.

Conflict of Interest Statement:

The authors declare no conflicts of interest.

Data Availability Statement:

The data presented in this study are available upon request from the corresponding author.

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