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Intestinal infections and probiotics

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Summary

The creator of the concept of probiotic - increasing the amount of bacteria beneficial to the body - was Miecznikow. In Poland in 1899, Brudziński described for the first time the treatment with lactic acid-producing bacteria, which later became the "probiotic". Research on the influence of these bacteria on the organism has shown many health effects over the last 20 years, including: prevention and support of intestinal infections, immune stimulation, restoration of eosinophilia, and inhibition of carcinogenesis. The effectiveness of probiotics depends on the type of strains. The article presents the importance of probiotic strains in supporting the treatment of gastrointestinal diseases on the basis of the literature. The probiotic strains contained in medicinal preparations have efficacy in the treatment of infectious diarrhoea in children, intestinal functional disorders and intestinal resistance regulation. They can be used in inflammatory bowel diseases to achieve remission. Not all products containing certain probiotic strains reduce the risk of post-antibiotic diarrhoea. Probiotics are generally considered safe for the body but in certain health situations they may have a negative impact.

Streszczenie

Twórcą koncepcji probiozy - zwiększenia ilości bakterii korzystnych dla organizmu - był Miecznikow. W Polsce w 1899 Brudziński po raz pierwszy opisał leczenie bakteriami produkującymi kwas mlekowy, które później otrzymały nazwę „probiotyk”. Prowadzone od 20 lat prace badawcze dotyczące wpływu probiotyków na organizm udowodniły wiele efektów

zdrowotnych m.in.: pobudzanie odporności, zapobieganie zakażeniom jelitowym, przywracanie eubiozy czy hamowanie karcynogenezy. Skuteczność probiotyków jest zależna od rodzaju szczepów. W artykule ukazano znaczenie szczepów probiotycznych we wspomaganiu leczenia chorób układu pokarmowego na podstawie piśmiennictwa. Szczepy probiotyczne zawarte w preparatach leczniczych wykazują skuteczność w leczeniu biegunek zakaźnych u dzieci, zaburzeń czynnościowych jelit oraz regulacji odporności jelitowej. Mogą być stosowane w nieswoistych zapaleniach jelit celem uzyskania remisji. Nie wszystkie produkty zawierające określone szczepy probiotyczne zmniejszają ryzyko wystąpienia biegunki poantybiotykowej. Wyniki leczenia zależą nie tylko od szczepów, ale są swoiste dla określonej populacji czy subpopulacji. Probiotyki są ogólnie uważane za bezpieczne dla organizmu, ale w pewnych sytuacjach zdrowotnych mogą mieć negatywny wpływ.

Introduction

The aging of the human body results from the poisoning of substances that have been produced by intestinal bacteria. Providing food with beneficial bacteria will eliminate pathogens from the digestive tract. He thought so Ilja Miecznikow, who lived from 1845 to 1916. Polish physician Brudziński in the "Medical Review" of 1899 described the treatment of intestinal infection infants born of *Proteus vulgaris* who have had clinical improvement following administration of lactic acid producing bacteria. The scientific discovery of the microbial world and the discovery of the antibiotic slowed down work on probiotics. The dynamic growth of multi-resistant strains and post-antibiotic intestinal inflammations contributed to the development of research on probiotic strains and the possibility of their use in restoring the balance of intestinal flora. At the turn of the 20th and 21st centuries there were publications of research on the use and effectiveness of probiotics as food additives called "functional food" having a preventive meaning and as preparations supporting the treatment of many diseases. Maintaining a specific balance of the intestinal flora in the process of human ontogeny determines its well-being and health. It plays an important role in the protection of the body against the invasion of pathogenic microorganisms. The intestinal flora syndrome is an individual feature, only 30% of microorganisms occur in most people, while 70% are microorganisms dependent on various endogenous and exogenous factors [1].

Throughout a person's life, changes in the amount and species of flora colonizing the digestive tract are observed. A modern lifestyle, a diet containing numerous preservatives and the abuse

of antibiotics lead to the degradation of the intestinal flora - dysbiosis and, as a consequence, to the development of the patient [2]. Reducing the risk of these diseases is possible through the reconstruction of the intestinal ecosystem. Proper diet and rational use of antibiotics helps maintain the balance of the intestinal flora and the delivery of probiotic bacteria to the body gives the possibility of restoring the disturbed balance. The aim of this article is to show the importance and use of probiotic strains in supporting the treatment of gastrointestinal diseases. A review of contemporary literature in this area was carried out using keywords: probiotic, diarrhea, enteritis.

Description of knowledge

The intensive development of various fields of science dealing with nutrition and the interest of scientists from around the world, enriching food with ingredients that may have a beneficial effect on the functioning of the human body have contributed to the dissemination of concepts such as probiotics, prebiotics and synbiotics. Lyophilisation of probiotic strains and administration in the form of a capsule allows the proper dosing of the probiotic and proper registration of the preparation.

The fulfilment of these conditions gives the possibility of using probiotics in specific disease entities. President of the Polish Probiotic and Prebiotic Society prof. Heczko emphasizes that a clear division should be made between probiotics contained in food that affect the general health of the body from the therapeutic effect of probiotic preparations registered as medications including the intermediate probiotic group having a preventive effect and occurring in the form of probiotics supplements. In recent years, the use of probiotics has increased in the prevention and treatment of many diseases and they obtain recommendations from scientific medical societies [3].

According to the FAO / WHO, probiotic strains may obtain recommendations for use in specific diseases only if health effects have been confirmed by independent scientific centres and the studies included a sufficiently large group of people and lasting long enough to show the influence of a given probiotic strain on the human body [1].

Effective action of probiotics has been demonstrated in diseases of the digestive system, immune system and immunologic diseases and the genitourinary system. Most clinical trials are associated with inflammation of mucous membranes. It was noticed that "no man controls his bacteria contained in the digestive tract, but the bacteria control the functioning of the human intestine" [4]. Properly supplied blood and properly functioning intestines increase the effectiveness in absorption of various components from food.

Probiotics in intestinal infections

The most common disorder of the digestive tract is diarrhea. It is a serious health problem especially in children and contributes to numerous hospitalizations. Occurs all over the world and according to CDC (Center of Disease Control) causes 4 - 6 million deaths per year [5]. Diarrhea accompanies all changes occurring in the composition of the physiological flora of the digestive tract. The therapy uses such mechanisms of action of probiotic strains as: receptor occupancy, production of bacteriocins that inhibit the development of pathogens, lower pH of intestinal contents and modification of bacterial toxin receptors [6]. Probiotics added to traditional treatment may modify therapeutic effects by shortening the disease period, alleviating symptoms or obtaining better treatment results. The clinical effect is dependent on the strain and is characteristic of a specific population [7]. The probiotic becomes an effective and harmless specificity, helpful in the intestinal infection caused by viruses and bacteria. The most common applications are strains of lactic acid from the genus *Lactobacillus* and *Bifidobacterium*.

Acute diarrhea – more and more often the cause of diarrheas with an acute course of the disease process are viruses, including Rotavirus or Norovirus. Among bacteria, the etiological factor is: enteropathogenic *Escherichia coli*, *Salmonella*, *Shigella* and *Campylobacter* [5]. Determining the aetiology of acute diarrhea in children is not always possible. This problem affects about 30% of cases [8].

In accordance with the recommendations of ESPGHAN and ESPID (European Society for Pediatric Infectious Disease), the basis for treatment of this disorder, irrespective of the etiological factor, is the symptomatic treatment consisting in oral replacement of water and electrolyte deficiencies. The course of acute diarrhea may also be affected by probiotic. In the case of using probiotics, the therapeutic or preventive effect depends on: the etiological factor of diarrhea, the time of introduction of the probiotic for treatment and the type of probiotic strain and its dose [9]. The three strains of *Lactobacillus rhamnosus* contained in the *Lakcid L* formulation shorten the duration of rotavirus diarrhea but have no effect on the duration of diarrhea of unknown aetiology [5]. The yeast probiotic *Saccharomyces boulardii* reduces the frequency of bowel movements and contributes to the improvement of stool consistency in infants and young children in the absence of efficacy in adults [10]. Therefore, the use of a probiotic requires knowledge about the effectiveness of the strain, the method of its dosage and the effect on the etiological factor and an individual view of the body found in a specific phase of physical development and the human health situation.

A variation of acute diarrheal diarrhea is travellers' diarrhea. *Lactobacillus rhamnosus* GG and *Saccharomyces boulardii* strains reduce the risk of diarrhea associated with travel to tropical countries where the etiological agent is mainly the enterotoxin strains of *Escherichia coli* [7]. Probiotics also have the effect of reducing the occurrence of travellers' diarrhea caused by *Staphylococcus aureus* and have documented efficacy in the treatment of chronic non-specific diarrhea [11,12]. For example, *Saccharomyces boulardii* has been shown to be effective in the treatment of chronic diarrhea in people with HIV [13].

Rotavirus diarrhoea - in recent years the number of children suffering from diarrhoea with viral aetiology has been increasing. Rotaviruses are responsible for 30 to 50% of acute gastrointestinal infections. Such a situation contributed to many scientific studies, which demonstrated the evident efficacy of the strain *Lactobacillus rhamnosus* GG in the course of rotaviral diarrhoea [12,5]. Reduced bowel movements can also be achieved by using *Saccharomyces boulardii* [13] or the preparation of Lakcid L containing three strains of *Lactobacillus rhamnosus* (573 / 1,573 / 2,573 / 3) [15].

Antibiotic diarrhoea - lack of rational antibiotic therapy leads to dysbiosis, which is the main pathogenetic mechanism of antibiotic diarrhea. It concerns 11 - 40% of children who have been treated with antibiotics. The use of probiotics reduces the risk of such diarrhoea by 60% [16]. In the case of antibiotic diarrhoea, the therapeutic effects are observed in the following strains: *Lactobacillus rhamnosus* GG, *Saccharomyces boulardii*, *Bifidobacterium lactis* Bb12 and *Streptococcus thermophilus* and *Lactobacillus rhamnosus* E/N, Oxy, Pen. *Saccharomyces boulardii* is more appropriate in patients treated with amoxicillin, amoxicillin with clavulanic acid or cefuroxime, who, due to their wide spectrum of effects, most often contribute to the occurrence of antibiotic diarrhea [10,17,18]. In hospitalized patients, drinking a yoghurt drink containing a specific strain of *Lactobacillus casei* (Actimel) during antibiotic treatment and 7 days after its completion brought benefits in the form of reduction of the risk of occurrence of both non-specific antibiotic diarrhoea and diarrhoea of *Clostridium difficile* aetiology [19,20]. Not all products containing probiotic strains reduce the risk of such diarrhoea. Both the bioyogurt with the addition of probiotic strains *Lactobacillus acidophilus* and *Bifidobacterium animalis* subspecies *lactis* [19] and the kefir containing ten probiotic strains [21] did not reduce the risk of antibiotic diarrhoea. Nor have the expected effects been obtained from the administration of two strains of *Lactobacillus acidophilus* and *Lactobacillus bulgaricus* in children treated with amoxicillin [22]. A commonly recommended method of preventing antibiotic diarrhoea is to limit the quantity and quality of these drugs. According to the recommendations of the experts of the National Programme for the Protection of Antibiotics,

an antibiotic should be used only in justified situations with a narrow and targeted scope of its action.

Clostridium difficile diarrhoea - excessive development of Clostridium difficile may occur due to dysbiosis caused by antibiotic therapy. This bacterium is the main etiological factor of pseudomembranous colitis, contributes to inflammatory bowel disease and is responsible for 15-25% of diarrhoea associated with antibiotic therapy. The use of probiotics gives the possibility of restoring eubiosis by increasing the number of lactic fermentation bacteria and reducing the pathogenic strain of C. difficile. In adults undergoing antibiotic therapy, prophylactic consumption of the probiotic drink (Actimel) containing the three probiotics Lactobacillus casei DN114 001, Streptococcus thermophilus and Lactobacillus bulgaricus reduces the risk of Clostridium difficile diarrhoea [6]. In the case of pseudomembranous bowel disease, better therapeutic effects may be achieved by supporting the therapy with S. boulardii [10].

Functional intestinal disorders - do not cause organic changes in the gastrointestinal tract. 10-15% of school-age children experience recurrent abdominal pain, mainly due to gastrointestinal flora disorders. Administration of the strain L. rhamnosus GG may reduce this ailment in children [23]. Among the problems encountered by child gastroenterologists, as many as 10-25% are defecation disorders. These children are diagnosed with dysbiosis, which is why probiotics restoring the balance of the intestinal flora and improving the motility of the gastrointestinal tract are used in the treatment of constipation. In the case of constipation in children, Bifidobacterium lactis DN-173 010 and a combination of L. casei Shirota and Escherichia coli Nissle 1917 strains demonstrated efficacy [24,25]. In adult constipations such strains as L. plantarum 299V, L. acidophilus, L. salivarius, Streptococcus faecium and the combination of probiotics contained in the preparation VSL#3 may be used [7,26]. Yoghurt enriched with Lactobacillus rhamnosus GG may have a positive effect on the frequency of bowel movements [25]. This strain in combination with lactulose did not reduce constipation in children aged 2-16 years [26]. Hypersensitivity bowel syndrome also lacks effectiveness [11]. Efficacy in the treatment of obstructions can be achieved by using S. boulardii strain, which reduces daily defecation [22].

Dead intestinal inflammation - one of the risk factors for this disease is intestinal immaturity, which occurs mainly in premature babies with low birth weight. It is associated with a high risk of infant death. The use of probiotic strains such as B. bifidum, B. lactis, B. infantis, L. acidophilus or L. rhamnosus GG in the form of various combinations in the study reduced the risk of necrotic enteritis and mortality among premature babies [11,27]. The European Society

for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) does not recommend the routine use of probiotics in infants (including milk mixtures with their addition) [28].

Inflammatory bowel diseases - in Poland there is an increase in the incidence of this group of diseases among children. These include Crohn's disease, ulcerative colitis and indeterminate colitis. They are characterized by a complex pathogenesis and a multiplicity of etiological factors. Immunological processes, or rather their defective activation, play a fundamental role in the development of these diseases [29]. The non-pathogenic strain *Escherichia coli* Nissle 1917 allows the period of remission of ulcerative colitis in adults to be prolonged [30]. In case of children, the probiotic preparation VSL#3 [31] had an effect on the induction of remission of the disease and its prolongation. Patients with Crohn's disease have dysbiosis with a reduced number of probiotic bacteria of the genera *Lactobacillus* and *Bifidobacterium* in favour of *E. coli* and *Bacteroides* spp. [2]. An attempt to restore bacterial balance with *L. rhamnosus* GG supplementation did not affect the clinical course of the disease in adults but brought promising results in children [11]. Supplementing the therapy with VSL#3 or *L. johnsonii* LA1 reduces the frequency of relapses in children [32]. A similar effect was demonstrated by *S. boulardii* strain, which also contributed to the reduction of bowel movements [22].

Infection with *Helicobacter pylori* aetiology - this problem affects about 50% of the world's population and is related to economic status. About 80% of people in Eastern Europe, Asia and developing countries are infected with this bacterium [33]. In Poland, around 15% of children are affected by this problem [34]. Eradication of *H. pylori* requires the use of two antibiotics (amoxicillin and clarithromycin or metronidazole). 5 - 30% of patients undergoing therapy show side effects such as nausea, vomiting or abdominal pain. Probiotics included in standard therapy may contribute to improving the effectiveness of treatment and reducing the incidence of side effects. For adults, standard *Saccharomyces boulardii* therapy improves eradication efficiency and reduces the risk of side effects [35]. Addition of *L. rhamnosus* GG to the treatment in children does not affect the effectiveness of the therapy and does not reduce the incidence of side effects from the gastrointestinal tract [36]. It may be appropriate to use *L. rhamnosus* and *L. acidophilus* strains, after which vomiting, abdominal pain and loose bowel movements are less common, for the coexistence of these strains [11].

Intestinal cancer - in developed countries, colorectal cancer is one of the main causes of death. 80% of these diseases are due to poor diet [37]. Enzymes of some intestinal bacteria play an important role in the process of cancer. Together with the food, pro-carcinogenic compounds enter the body, which can be activated by intestinal microorganisms [38]. Probiotic strains (*L. acidophilus*, *B. longum*, *B. infantis*) may inhibit carcinogen activity. The use of *L. casei*

(LC9018) leads to the activation of immune response mechanisms against cancer cells [31]. The strains *L. rhamnosus* GG and *B. lactis* Bb12 may lead to the reduction of colorectal tumours [32]. Probiotics can also reduce the negative effects associated with chemotherapy, radiotherapy or surgical intervention. Use of a symbiotic containing *B. breve* and *L. casei* during the postoperative period may reduce the risk of hospital infection associated with biliary tract and liver resection in the course of cancer [39].

Restrictions on the use of probiotics

The studies have shown that probiotic strains have a beneficial effect on the organism in which the immune system functions properly. However, they may be the cause of opportunistic infections, and the risk of leading the body to infection when using probiotics is described as negligible [40,41]. It is justified to limit or waive the use of probiotics in premature infants, in immunosuppressed patients and in intensive care unit patients [42]. Prof. Rydzewska (2009) states that "there is serious evidence that at least some strains may have harmful effects, increasing mortality in the course of acute pancreatitis" [43].

Summary

The probiotic scientists believe that certain probiotic strains are effective in treating infectious diarrhoea in children, in intestinal functional disorders, in inflammatory bowel disease for remission and in regulating intestinal immunity. The efficacy of probiotics in constipation, prevention of antibiotic diarrhoea and *C. difficile* diarrhoea is a controversial issue. Probiotic strains do not affect probiotics in the reduction of obesity and diabetes, treatment of lipid metabolism disorders, prevention of urinary tract diseases and HIV prevention [33]. In clinical trials, different probiotic components are used at different strain doses, sometimes in combination with a probiotic substance. Therefore, the prophylactic or therapeutic efficacy should not be clearly attributed solely to a specific probiotic strain. Although probiotic bacteria are widely recognised as safe (GRAS - General Recognized as Safe), their use in clinical practice cannot be based solely on the positive effects considered by the GRAS criterion. Important information for therapeutic purposes is also their negative impact on the human body in a specific health situation.

Literature

1. Nowak A, Libudzisz Z. Zespół mikroorganizmów jelitowych – czy wiemy, jaki powinien być? *Standardy Med Pediatr* 2009; 6: 56-61.
2. Sobieszcańska B. Rola bakterii w chorobie Leśniowskiego-Crohna. *Pediatr Współcz Gastroenterol Hepatol Żywnienie Dziecka* 2010; 12: 38-40.
3. Spaczyński M, Drews K, Kotarski J i wsp. Rekomendacje Polskiego Towarzystwa Ginekologicznego do stosowania preparatu Lacibios Femina w położnictwie i ginekologii. *Ginek Prakt* 2006; 4: 39-40.
4. Łoś – Rycharska E, Czerwionka-Szaflarska M. Biegunki rotawirusowe – dlaczego warto im zapobiegać. *Prz Gastroenterol* 2011; 6: 60-68.
5. Czerwionka-Szaflarska M, Adamska I. Ostra biegunka u dzieci – najnowsze wytyczne. *Forum Med Rodzinnej* 2009; 3: 431–438.
6. Szajewska H. Probiotyki w chorobach infekcyjnych przewodu pokarmowego i dróg oddechowych. *Standardy Med Pediatr* 2009; 6: 915-921.
7. Cichy W, Gałęcka M, Szachta P. Probiotyki jako alternatywne rozwiązanie i wsparcie terapii tradycyjnych. *Zakażenia* 2010; 10: 45-54.
8. Łoś – Rycharska E, Czerwionka-Szaflarska M. Biegunki rotawirusowe – dlaczego warto im zapobiegać. *Prz Gastroenterol* 2011; 6: 60-68.
9. Hojsak I, Szajewska H, Canani R.B, Guarino A, Indrio F, Kolacek S, Orel R, Shamir R, Vandenplas Y, Goudoever J, Weizman Z. Probiotics for the Prevention of Nosocomial Diarrhea in Children. *Journal of Pediatric Gastroenterology and Nutrition*. 2018; 66: 3–9. DOI: 10.1097/MPG.0000000000001637 – 12.02.2018.
10. Albrecht P., Kotowska M. *Saccharomyces boulardii* – znaczenie dla ochrony przewodu pokarmowego dzieci. *Zakażenia* 2011; 11: 36-42.
11. Czerwionka-Szaflarska M, Romańczuk B. Probiotyki w profilaktyce i leczeniu wybranych schorzeń przewodu pokarmowego u dzieci. *Forum Med Rodzinnej* 2010; 4: 135-140.
12. Heczko P, Strus M, Jawień M i wsp. Medyczne zastosowanie probiotyków. *Wiad Lek* 2005; LVIII (11-12): 640-646.
13. Albrecht P., Kotowska M. *Saccharomyces boulardii* – znaczenie dla ochrony przewodu pokarmowego dzieci. *Zakażenia* 2011; 11: 36-42.

14. Dubiel B., Szajewska H. Ocena skuteczności mieszanki trzech szczepów probiotyków z rodzaju *Lactobacillus rhamnosus* w leczeniu ostrej biegunki o etiologii zakaźnej u dzieci. *Med Prakt Pediat* 2007; 1: 103-106.
15. Szymański H, Pejcz J, Jawień M i wsp. P. Skuteczność szczepów *Lactobacillus rhamnosus* (573L/1, 573L/2, 573L/3) w leczeniu ostrej biegunki u dzieci. *Zakażenia* 2005; 5: 36-40.
16. Szajewska H. Zastosowanie synbiotyków u dzieci. *Zakażenia* 2010; 10 (5): 44-48.
17. Ruszczyński M, Szajewska H. Probiotyki w zapobieganiu biegunce związanej ze stosowaniem antybiotyków – aktualizacja metaanalizy badań z randomizacją. *Pediatr Współcz Gastroenterol Hepatol Żywnienie Dziecka* 2008; 10: 96-104.
18. Czerwińska-Szaflarska M, Gąsiorowska J. Zastosowanie *Lactobacillus rhamnosus* GG w profilaktyce biegunki związanej z antybiotykoterapią. *Zakażenia* 2011; 11: 58-61.
19. Ruszczyński M, Szajewska H. Probiotyki w zapobieganiu biegunce związanej ze stosowaniem antybiotyków u dzieci. *Zakażenia* 2009; 9: 46-52.
20. Iwulska K, Leśniak W, Jaeschke MD MSc R. Stosowanie probiotycznego napoju jogurtowego zawierającego określony szczep *Lactobacillus casei* w zapobieganiu biegunce związanej ze stosowaniem antybiotyków. *Med Prakt Pediat* 2007; 9: 119-122.
21. Dubiel B, Szajewska H. Ocena skuteczności kefiru w zapobieganiu biegunce związanej z antybiotykoterapią u dzieci. *Med Prakt Pediat* 2010; 2: 75-77.
22. Lifschitz C. *Saccharomyces boulardii* – ponownie odkryty probiotyk. *Standardy Med Pediat* 2010; 7: 781-790.
23. Dubiel B, Szajewska H. *Lactobacillus* GG w leczeniu czynnościowego bólu brzucha u dzieci. *Med Prakt Pediat* 2011; 2: 100-103.
24. Albrecht P, Kotowska M. Indywidualizacja działania probiotycznych szczepów bakteryjnych stosowanych w różnych schorzeniach. *Zakażenia* 2011; 11: 54-60.
25. Wojtyniak K, Szajewska H. Systematic review: probiotics for functional constipation in children. *Eur J Pediatr* 2017; 176: 1155–1162. DOI 10.1007/s00431-017-2972-2.
26. Tabbers MM, Diloranzo C, Berger MY, Faure C, Langendam MW, Nurko S, Staiano A, Vandenplas Y, Benninga MA. Evaluation and treatment of functional constipation in infants and children: evidence-based recommendations from ESPGHAN and NASPGHAN. *J Pediatr Gastroenterol Nutr* 2014; 58: 265–281.
27. Dubiel B, Szajewska H. Rola probiotyków w zapobieganiu martwiczemu zapaleniu jelit u wcześniaków - metaanaliza. *Med Prakt Pediat* 2010; 6: 97-99.

28. Jańczyk W. Suplementacja mieszanek dla niemowląt probiotykami i/lub prebiotykami – stanowisko Komitetu Żywnienia ESPGHAN. *Standardy Med Pediat* 2011; 8: 51-55.
29. Iwańczak B, Iwańczak F. Nowe trendy w leczeniu nieswoistych zapaleń u dzieci. *Standardy Med Pediat* 2010; 7: 473-482.
30. Szajewska H, Horvath A, Dziechciarz P. Probiotyki, prebiotyki i synbiotyki w leczeniu nieswoistych zapaleń jelit – przegląd systematyczny. *Pediat Współcz Gastroenterol Hepatol Żywnienie Dziecka* 2007; 9: 266-275.
31. Górka S, Jarzab A, Gamian A. Bakterie probiotyczne w przewodzie pokarmowym człowieka jako czynnik stymulujący układ odpornościowy. *Postępy Hig Med Dośw* 2009; 63: 653-667.
32. Nowak A, Śliżewska K, Libudzisz Z, Socha J. Probiotyki – efekty zdrowotne. *Żywność Nauka Technologia Jakość* 2010; 4: 20-36.
33. Kowalska-Duplaga K. Probiotyki w leczeniu eradykacyjnym *Helicobacter pylori*. *Zakażenia* 2006; 6: 56-61.
34. Kwiecień J. Zmieniająca się epidemiologia zakażeń *Helicobacter pylori* u dzieci. *Standardy Med Pediat* 2010; 7: 800-806.
35. Piwowarczyk A, Horvath A, Szajewska H. Wpływ *Saccharomyces boulardii* na skuteczność leczenia eradykacyjnego zakażenia *Helicobacter pylori*. *Zakażenia* 2011; 11: 49-53.
36. Dubiel B, Fyderek K. Ocena skuteczności i bezpieczeństwa suplementacji *Lactobacillus GG* podczas leczenia zakażenia *Helicobacter pylori* u dzieci. *Med Prakt Pediat* 2010; 2: 78-80.
37. Nowak A, Libudzisz Z. Karcynogeny w przewodzie pokarmowym człowieka. *Żywność Nauka Technologia Jakość* 2008; 4: 9-25.
38. Nowak A, Libudzisz Z. Karcynogenna aktywność mikroorganizmów jelitowych. *Żywność Nauka Technologia Jakość* 2008; 6: 25-39.
39. Drews M, Marciniak R. Zapobieganie zakażeniom chirurgicznym i ich leczenie. *Med Prakt Chir* 2006; 2: 17-26.
40. Kirjavainen PV, Apostolou E, Salminen SJ i wsp. Nowe aspekty stosowania probiotyków w leczeniu alergii pokarmowej. *Alerg Astma Immun* 2001; 6: 1-6.
41. Agostini C, Buonocore G, Carnielli VP i wsp. Żywnienie enteralne noworodków urodzonych przedwcześnie. *Med Prakt Pediat* 2010; 4: 47-56.
42. Szajewska H. Zastosowanie probiotyków w pediatrii. *Standardy Med* 2008; 5: 380-392.
43. Rydzewska G. Nowe trendy prognozowania i leczenia ostrego zapalenia trzustki. *Pol Merk Lek* 2009; XXVI (155): 550-556.