Modulation of intestinal microbioth with probiotics and their relationship to obesity

Modulação da microbiota intestinal com probióticos e sua relação com a obesidade

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RESUMO

Objetivo: Avaliar os resultados a partir da modução intestinal com probióticos no tratamento da obesidade. **Método:** Foram realizados levantamentos bibliográficos nas bases de dados PUBMED, SCIELO e LILACS, publicados de 2006 a 2018, com as palavras- chave: probióticos, microbioma gastrointestinal e obesidade. **Resultados:** Nos estudos avaliados as cepas com maior utilização em animais e humanos foram as dos gêneros Lactobacillus e Bifidobacterium. Dentre os achados, a redução do peso e massa corporal, a diminuição da circunferência da cintura, gordura corporal e visceral foram os resultados mais encontrados. **Conclusão:** Apesar dos resultados, os trabalhos ainda apresentam poucas informações sobre a quantidade de cepas administradas e tempo de tratamento para o uso em prática clínica além da limitação das pesquisas em humanos sendo necessários mais estudos para o direcionamento da utilização de probióticos no tratamento da obesidade.

Descritores: Probióticos; Microbioma gastrointestinal; Obesidade..

ABSTRACT

Objective: To evaluate the results from intestinal modulation with probiotics in the treatment of obesity. **Method:** We carried out bibliographic surveys in the databases PUBMED, SCIELO and LILACS, published from 2006 to 2018, with the key words: probiotics, gastrointestinal microbiome and obesity. **Results:** In the evaluated studies the strains with the highest use in animals and humans were those of the genera Lactobacillus and Bifidobacterium. Among the findings, the reduction of body weight and body mass, waist circumference decrease, body fat and visceral fat were the most frequent results. **Conclusion:** Despite the results, the studies still present little information about the amount of strains administered and the time of treatment for use in clinical practice, besides the limitation of the research in humans, and further studies are necessary to guide the use of probiotics in the treatment of obesity .

Descriptors: Probiotics; Gastrointestinal microbiome; Obesity.

REVIEW

Introduction

Obesity has been a cause for many years, but due to the knowledge of its causes and consequences, it has been considered a chronic noncommunicable disease - NCD. It is estimated that this disease may be genetically influenced from 25% to 40% of cases, but the other factors come from lifestyle in relation to eating habits and sedentary lifestyle, being considered the major determinants of weight gain in the world.[1]

According to the World Health Organization, in 2018, at least 150 minutes of moderate-intensity physical activity per week is required for individuals aged between 18-64 years to maintain their health, yet studies in African regions have shown that populations maintain a mass index. body-BMI with eutrophic classification from 8 hours of daily physical activity, ie, beyond the recommended.[2] From studies in other regions of the world and the search for the relationship between weight gain and lifestyle of these populations, it was possible to raise hypotheses about the existence of genes that facilitate weight gain, known as the genetic map of human obesity. Thus, it is known that adipose tissue can produce substances such as proteins called Toll-like receptors (TLRs) that are able to identify pathogens and respond to the liposaccharides (LPS) of gram-negative bacterial walls.[3]

Lipolysis, resulting from adipose tissue, increases free fatty acids that bind to TLR subtype 4 (TLR-4) by stimulating immune response with consequent low-grade inflammation, which is related to insulin resistance. Since mice without TLR-4 are protected from the development of metabolic diseases in the face of a high-fat diet.[1]

The intestinal microbiota has been studied in relation to its action in several metabolic diseases. Although dietary behaviors are an important factor leading to the improvement and normalization of intestinal health and consequently its microbiota, more targeted interventions are strategies to stimulate the growth of beneficial species.[4-6]Research on intestinal microorganisms has presented a new approach from supplementation of probiotics (living bacteria that generate health benefits when ingested) to intestinal modulation, which aids in host health. Studies and results between obese and lean animals may intensify research for more satisfactory results regarding decreased body fat accumulation.[7]

Obesity is an inflammatory disease mediated by oxidative stress and inflammatory agents that modify the intestinal structure by altering good bacteria and increasing obesogenic bacteria such as Bacterioids and Firmicutes, respectively. Thus the action of beneficial microorganisms such as the probiotics of Lactobacillus and Bifidobacterium species would be important for the reduction of these systemic manifestations.[8] Due to the worldwide progress of obesity and its health implications, as well as the evidence on the difference in the intestinal microbiota of eutrophic and obese individuals, research is needed to promote the prevention and treatment of this disease.

The aim of this study was to present from the literature review studies and their results regarding the consumption of probiotics and consequently their effects on the treatment of obesity presenting weight and body measures improvement as well as intestinal function improvement in people suffering from obesity. this disease.

Method

This is an integrative literature review on the subject regarding the use of intestinal modulation with probiotics in obese patients, including scientific articles published in indexed databases and full-text databases from 2006 to 2018.

The bases used were: US National Library of Medicine (PUBMED), Scientific Electronic Library Online (SCIELO) and Latin American and Caribbean Health Sciences Literature (LILACS), including articles published from 2006 to 2017 using the following keywords in english: probiótics, obesity e microbioma gastrointestinal separated by the boleaders "AND" and "OR" and the following keywords in Portuguese: probióticos, obesidade and microbiota intestinal separated by the boleaders "E" and "OU".

The selection of articles was based on the selection in the languages: Portuguese, English and Spanish. Animal and human researches were included, including original articles and meta-analyzes according to those described above, as well as the theme in question. Articles that did not present the use of probiotics as part of treatment for obesity and / or metabolic diseases or within the selected period were excluded.

Results and Discussion

According to the criteria mentioned above, 201 articles were obtained from the different search banks used, and 165 articles were discarded after the use of the filters related to the period, language and type of study, where 36 articles eligible for literature review were selected.

After analyzing the articles with the presentation of studies in animals and humans, among the outcomes, changes were observed regarding the reduction of body mass index (BMI), reduction of waist and hip circumference, reduction of body weight and visceral fat. , improvement in insulin resistance such as decreased hyperglycemia, reduced proinflammatory cytokines, positive change in lipoproteins such as increased HDL (high density lipoprotein) and decreased LDL (low density lipoprotein), in addition to reduction in triglyceride and total cholesterol (TC) levels.

The intestinal microbiota

Intestinal microorganisms are defined as the group of bacteria associated with humans. They are microbial cells that maintain a symbiotic relationship to maintain health from the balance of intestinal flora. It is estimated that there are over 1,000 species of microbial cells that contribute to the health of those who harbor them; being studied for understanding and treating metabolic syndrome and other diseases.[9]

The study of intestinal microbiota was based on evidence of its benefits to human health. In 1908 Elie Metchnikoff noted that fermentative bacteria present in milks favored intestinal health by altering the pathogenous and beneficial intestinal flora, which led him to the Nobel Prize at the Pasteur Institute.[10]

The intestinal microbiota is present in the human intestines and is protected by the ability to block pathogenic bacteria that generate imbalance in the environment causing various local and systemic diseases. By the time of birth the intestine is free of bacteria, but at birth properly normal birth, the baby has its first contact with the mother's microbiota strengthening this system in breastfeeding keeping the microbiota diversified.[11]

Among the benefits of the microbiota-host relationship are antibacterial function, immunomodulatory function, nutritional metabolism, and intestinal mucosal restructuring.[12] Other benefits are autoimmune system aids, regulation of body fat aggregation, food degradation and production of vitamin K, B12, folic acid, biotin and pantothenic acid.[9]

The intestinal microbiota also has the function of efficiently extracting energy through fibrous carbohydrates (starches, oligosaccharides and polysaccharides), producing short chain fatty acids (AGCC) that will be transformed into energy for the host.[9]

AGCC produced by healthy microbiota may increase GLP-1 secretion (which improves insulin sensitivity), increase YY peptide secretion (which induces satiety), and decrease fat deposition in adipose tissue. Thus, individuals with poor dietary habits and poor overall lifestyles may suffer from dysbiosis causing the bacteria that produce AGCC to shrink by increasing pathogenic bacteria and thus creating a diseased intestinal environment.[13]

Investigations into human intestinal cells have shown that there are at least 5 different phyla of microorganisms: *Bacteroidetes* (gram-negative), *Firmicutes* (gram positive), Proteobacteria, Actinobacteria and Verrucomicrobia, but the phyla of *Firmicutes* and *Bacteroidetes* have a higher proportion in the gut. human.[14]

Firmicutes bacteria are found in larger numbers in the obese adult organism and carry out fermentation of insoluble carbohydrates - modification of complex carbohydrates in glucose and short chain fatty acids, ie, can increase fat accumulation.

Bacteroidetes are found in smaller quantities and utilize carbohydrates more simply from metabolizing insoluble carbohydrates.[9] The composition of the intestinal microbiota can be altered by diet, age and genetics.[15] The microbiota in healthy individuals has more resistant characteristics that can overcome physiological changes such as senility. Thus becoming a tool for diagnosis and prevention of diseases in various age groups.[16]

The intestinal microbiota in obesity

Obesity is characterized by being a disease in which the individual has high accumulation of body fat. It is currently one of the chronic noncommunicable diseases assessed as a major public health problem by the World Health Organization with high numbers of mortality and morbidity worldwide.[8]

According to the World Health Organization, 2014 In addition to obesity, overweight also increases mortality and morbidity rates in adults and children, due to the association of other diseases such as diabetes mellitus, heart disease and some cancers.[17]

In its guideline, the Brazilian Association for the Study of Obesity and Metabolic Syndrome - ABESO presents as actions, after diagnosis, the change in lifestyle with the necessary pharmacological treatments, dietary treatments, cognitive behavioral therapies, surgical treatments and even heterodox therapies. nutritional supplements to aid weight loss. Different guidelines practices that emphasized caloric restriction for 5% to 10% weight loss within 6 months, but with consequent weight regain after this period.[18]

Thus, complementary actions are needed beyond those used for the management and prevention of obesity. In response to this need, the link between obesity and intestinal microbiota constitution has been studied in recent years.[19]

Animal prototype studies have shown the difference between the intestinal microbiota of obese animals and lean animals. The study by Ley et al, 2005[20], when analyzing the bacterial sequences of the distal intestine genes of obese and lean animals fed the same diet, found that obese animals had a reduction in Bacteroidetes and a higher proportion of Firmicutes compared to thin rats.

In another study by Ley et al, 2006[21], it was observed that intestinal microbiota transplantation from obese to lean animals promoted an increase in their body percentage compared to intestinal microbiota transplantation from lean to obese rats, even with food control in both cases, in addition to the identical initial weight.

Lipopolysaccharides (LPS) are glycolipids found in the membranes of gram-negative bacteria, which can generate endotoxemia, leading to subclinical and chronic inflammatory responses from hyperlipidic diets, which facilitate their uptake by intestinal villi. Upon reaching the bloodstream HDL (High Density Lipoprotein) receives LPS which follows the mechanism of being eliminated by the bile, but in decreasing HDL in the body, the LPS binding protein transfers this substance to LDL (Lipoprotein low density).[1]

According to Silva Junior, et. al, 2017[1] adipose tissue has the ability to produce substances that act on the immune response. Toll-like receptor membrane proteins (TLR-4) are formed due to excess fat and free fatty acids that bind to TLR subtype 4. These proteins can respond to lipopolysaccharides and initiate immune responses due to their activation, increasing inflammatory expression in the obese organism which can lead to morbidities such as obesity or diabetes development due to insulin resistance.

Studies on the relationship between intestinal microbiota and obesity are still limited, but there are important results in the action of intestinal microbiota intervention in the amount of calories ingested, the increase in lipoprotein lipase (LPL) increasing systemic inflammation, activity lipogenesis and the endocarbinoid system (ECB) that regulates physiological processes throughout the body such as pain, mood and appetite.[22]

The use of probiotics in obesity

Probiotics are defined by the World Health Organization as living microorganisms that give health to those who properly consume them. Microorganisms to be characterized in probiotics must be identified by strain levels by genotypic methods and phenotypes, as there are several strains specific to certain functions in the body. In addition, in vitro studies with effective animal and human results are required.[23]

Among the most commonly used genera of probiotics in food products are *Lactobacillus* and *Bifidobacterium*, which from the fermentative activity generate organic compounds that alter intestinal acidity and prevent the growth of pathogenic microorganisms.[12] According to the World Health Organization, 2001[24] for the use of probiotics in food products the probiotic must have sufficient resistance after ingestion to reach the intestine safely.

In order for the expected activity to be carried out in the body by the probiotic, a minimum number of strains of bacteria, such as *L. rhamnous*, are required for the treatment of diarrhea; 109 CFU/g of strains are required for this purpose.[12]

The action of probiotics is to decrease the population of pathogenic bacteria by stimulating the mucosa through the immune system and increasing the proportion of beneficial bacteria. Thus, effects such as decreased diarrhea and decreased incidence in colon cancer are observed in animal studies and further studies are needed to treat other diseases in humans.[25]

Probiotics are derived from beverages, supplements and fermented foods over time and their human health benefits increase attention to the treatment of diseases such as obesity due to the regulation of energy balance and body fat concentration in animals.[26]

In 2010, Kadooka et al, 2010 observed from supplementation of *Lactobacillus gasseri*, in individuals during 12 weeks, the reduction of visceral and subcutaneous fat, in addition to weight, waist and hip circumference and BMI in overweight adults, compared with the group that just received fermented milk.[27]

Researchers in a study of diabetic and overweight patients analyzed that the group that was supplemented with probiotic (yogurt composed of *Lactobacillus acidophilus and Bifidobacteria*) showed beneficial results over the group with conventional food, such as decreased basal glucose and glycated hemoglobin, besides fasting blood glucose.[28]

The results of a study conducted only from the supplementation of BNR17 (*Lactobacillus gasseri*) in a control group using probiotic for 12 weeks was possible to analyze the decrease in waist circumference, hip and body weight, even if the group did not have change in diet or eating behavior.[29]

In a study conducted in 2013 with hypertensive and obese grade II adults for 3 weeks, the hypocaloric diet and probiotic cheese group showed higher body weight loss, BMI decrease and triglyceride reduction compared to the same diet group, however. without the probiotic. According to the researchers, a diet supplemented with probiotic cheese may reduce the risk for metabolic syndrome in hypertensive and obese patients.[30]

Obese mice supplemented with *Lactobacillus curvatus* HY7601 and *Lactobacillus plantarum* KY1032 after the intervention had improved body mass with reduced body weight and body fat index, reduced liver toxicity flags, total cholesterol, leptin and insulin levels, as well as intestinal bacteria have been modified after probiotic consumption.[31]

A study[32] found a reduction in body mass in the administration of Bifidobacterium CECT 7765 in obese mice with improvement in total cholesterol, triglycerides and plasma glucose levels, as well as proinflammatory markers and leptin.

The authors of an analysis noted that oral gavage administration of 120 mg of *Saccharomyces boulardii* probiotic yeast reduced body fat as well as fat mass and systemic inflammation in obese rats showing changes in gut flora constitution.[33]

Authors of prebiotic supplement fructooligosaccharide (FOS) and probiotic *Bifidobacterium animalis* subsp. Lactis BB-12 (BB-12) in purposely obese mice by diet over a period of 8 weeks, it was observed that only in relation to the probiotic there was a decrease of *Firmicutes* bacteria, improved fasting insulin levels and increased peptide levels. equivalent to glucagon-2 (GLP-2), although there was no influence on body weight.[34]

Nuñes et al, 2014[35] when analyzing the action of *Lactobacillus casei* CRL 431 bacteria and milk fermented by the same bacterium for 60 days in obese rats observed a reduction in total cholesterol (TC), low density lipoprotein (LDL-C) levels. c) triglycerides and glucose. Results similar to those found in another study that supplemented *Lactobacillus plantarum* NS5 mice.[36]

In another study, it was observed that obese rats, from a high-fat diet, followed by supplementation of *Lactobacillus sakei* 0K67 over a period of more than 4.5 weeks, observed a decrease in hyperglycemia, low weight gain and decreased adipogenesis, in addition to the reduction of proinflammatory cytokines and increased interleukin-10.[37]

The study analyzed the use of probiotic LPR (*Lactobacillus rhamnosus*) in two phases (period of weight loss and period of weight maintenance) in groups of women. Weight loss and fat mass in the LPR supplementation group of women after 12 weeks was higher than in the placebo group, and weight loss in the weight maintenance phase was also higher in these women.[38]

In the study by Gomes, 2014[39] when using probiotics over an 8-week period performed with 43 overweight women associating three bacteria (*Lactobacillus acidophilluise casei*; *Bifidobaterium Bifidum* and *Lactis*) it was observed that supplementation aided in reducing waist circumference, body mass and low density lipoprotein (LDL).[39]

In observation, it was evaluated that obese women supplemented with probiotic DUOLAC 7 formulation consisting of 7 species of lactic acid microorganisms and bifidobacteria within 8 weeks showed weight reduction and body fat percentage, body mass index (BMI). as well as decreased waist circumference and increased high density lipoprotein (HDL-c).[40]

Brahe et al, 2015[41] in supplementing the L.paracasei F19 bacteria together with maltodextrin for 6 weeks in postmenopausal obese women, there were no relevant results regarding anthropometry, lipid levels, insulin and sensitivity, or even proinflammatory markers.

Final considerations

Research aimed at analyzing intestinal bacteria and their relationship with obesity presents a new approach based on the supplementation of probiotics in intestinal modulation, which generate health benefits for the host. From animal and human studies it is possible to evaluate the relationship between probiotic manipulation and its action on obesity. However, there is still little and divergent information on the amount of doses of the strains, time of treatment, population evaluated and the forms of administration, precluding conducts defined in clinical practice.

The most used strains in the studies were Lactobacillus and Bifidobacterium, as well as other gram-positive bacteria. The results from supplementation with probiotics in the treatment of obesity were: reduction in body mass index (BMI), reduction in waist and hip circumference, reduction in body weight and visceral fat, improvement in resistance to insulin such as decreased hyperglycemia, reduced proinflammatory cytokines, positive lipoprotein change such as increased HDL (high density lipoprotein) and decreased LDL (low density lipoprotein), as well as reduced triglyceride and cholesterol levels total (TC).

Studies in humans have increased in recent years compared to those in animals, which provides more information about the results and specific strains more suitable for treatment, and most studies have shown positive results on the administration of probiotics in obesity intervention.

Based on these data, further studies are needed to determine the most suitable bacteria, as well as their period of use and amounts administered, in order to evaluate the real effects of supplementation on obesity treatment.

References

1. Silva Junior VL, Lopes FAM, Albano RM, Souza MGC, Barbosa CML, Maranhão PA, et al. Obesity and gut microbiota: what do we know so far? Medical Express, 2017; 4:1-11.
2. Carvalho Filho MA, Pauli JR, Ropelle ER, Cintra DEC. Obesidade e diabetes: da origem ao caos. Obesidade e Diabetes: Fisiopatologia e Sinalização Celular.Sarvier Editora de Livros Médicos, 2011; 1 (8): 2-10.
3. Beutler B, Hoebe K, Du X, Ulevitch RJ. How we detect microbies and respond to them: the Toll- like receptors and their transducers. Journal Leukoc Biol, 2003; 74 (4): 479-485.
4. Cotillard A, Kennedy SP, Kong LC, Prifti E, Pons N, Le Chatelier E, et al. Dietary intervention impact on gut microbial gene richness. Nature, UK, 2013; 500 (7464): 585-588.
5. Delzenne NM, Neyrinck AM, Cani PD. Gut microbiota and metabolic disorders: How prebiotic can word? British Journal of Nutrion, UK, 2013; 109 (Suppl 2): 81-85.
6. Hernell O, West CE. Clinical effects of probiotics: scientific evidence from a paediatric perspective. British Journal of Nutrion, UK, 2013; 109 (Suppl 2): 70-75.
7. Turnbaugh PJ, Ley RE, Mahowald MA, Magrini V, Mardis ER, Gordon JI. Na obesity-associated gut microbiome with increased capacity for energy harvest. Nature. USA, 2006; 444: 21-28.
8. Oliveira JMS, Santos GM, Saldanha NMVP, Sousa PVL, Carvalho ACS. Efeitos de probióticos no tratamento da obesidade. Revista Eletrônica da FAINOR: Vitória da Conquista, 2017; 10 (2): 154-165.
9. Valero Y, Colina J, Herrera H. La microbiota intestinal y su rol en la diabetes. Anales Venezolanos de Nutrición: Venezuela, 2015; 28 (2): 132-144.
10. MACHOWIAK, P.A. Recycling Metchnikoff probiotics: the intestinal microbiome and the quest for long life. Frontiers in

public health, v.1, n. 52, 2013.
11. Paixão LA, Castro FFS. A colonização da microbiota intestinal e sua influência na saúde do hospedeiro. Ciências da Saúde, Brasília, 2016; (1): 85-96.
12. Sturmer ES, Casasola S, Gall MC, Gall MC. A importância dos probióticos na microbiota intestinal humana. Revista Brasileira de Nutrição Clínica: Rio grande do Sul, 2012; 27 (4): 4-72.
13. Khan MJ, Gerasimidis K, Edwards CA, Shaikh MG. Role of gut microbiota in the aetiology of obesity: proposed mechanisms and review of the literature. Journal of Obesity, 2016; 8: 1-27.
14. Tremaroli V, Bäckhed F. Functional interactions between the gut microbiota and host metabolim. Nature 2012; 489: 242-249.
15. Wu GD. Lining Long- Term Dietary Patterns with gut microbial enteropypes.Science, 2011; 334 (6052):105-108.
16. Faith JJ. Guruge JL, Charbonneau M, Subramanian S, Seedorf H, Goodman AL. The long-term stability of the human gut microbiota. Science, 2013; 341: 6141.
17. Food and Agriculture Organization and Word Helth Organization. Obesity and overweight. Facts sheet nº 311. 2014. Disponível em <http://www.who.int/mediacentre/factsheets/fs311/en/>. Acesso em 18 fev. 2018.
18. ABESO. Associação Brasileira para o Estudo da Obesidade e da Síndrome Metabólica. Diretrizes brasileiras de obesidade. São Paulo, 4º ed, 2016.
19. Clarke SF, Murphy EF, Nilaweera K, Ross PR, Shanahan F, O'toole PW, et al. The gut microbiota and its relationship to diet and obesity: New insights. Gut Microbes, 2012; 3 (3): 186–202.
20. Ley RE, Backhed F, Turnbaugh P, Lozupone CA, Cavaleiro RD, Gordon JI. Obesity alters gut microbial ecology. Proceedings of the National Academy of Sciences of the United States of America, USA, 2005; 102 (31):11070–11075.
21. Ley RE, Turnbaugh PJ, Klein S, Gordon JI. Microbial ecology: human gut microbes associated with obesity. Nature London, 2006; 444 (7114): 1022-1023.
22. Blaut M, Klaus S. Intestinal microbiota and obesity. Handbook of Experimental Pharmacology, 2012; 209: 251-273.
23. Food and Agriculture Organization and Word Helth Organization . Guidelines for the Evaluation of Probiotics in Food. 2002. Disponível em <http://www.lume.ufrgs.br/bitstream/handle/10183/108988/000948985.pdf?sequence=1>. Acesso em 18 fev. 2018.
24. Food and Agriculture Organization and Word Helth Organization .. Health and Nutricional Properties of Probiotics in Food including Powder Milk whit Live Lactic Acid Bacteria. 2001. Disponível em <http://www.fao.org/3/a-a0512e.pdf>. Acesso em 18 fev.2018.
25. Worldgastroenterology. Guias Mundiais da WGO. 2011. Disponível em

<http://www.worldgastroenterology.org/UserFiles/file/guidelines/probioticsportuguese-2011.pdf>. Acesso em 19 fev. 2018.

26. Arora T, Anastasovska J, Gibson G, Tuohy K, Sharma R, Bell J. Effect of Lactobacillus acidophilus NCDC 13 supplementation on the progression of obesity in diet- induced obese mice. British Journal of Nutrition, 2012; 108: 1382–1389.

27. Kadooka Y, Sato M, Ogawa A, Miyoshi, Uenishi H, Ogawa H. Effect of Lactobacillus gasseri SBT2055 in fermented milk on abdominal adiposity in adults in a randomised controlled trial. British Journal of Nutrition, 2013; 110: 1696–1703.

28. Ejtahed HS, Mohtadi-Nia J, Homayouni-Rad A, Niafar M, Asgharijafarabadi M, Mofid V. Probiotic yogurt improves antioxidant status in type 2 diabetic patients. Nutrition, 2012; 28 (5): 539-543.

29. Jung S P, Lee KM, Kang JH, Yun SI, Park HO, Moon. Effect of Lactobacillus gasseri BNR17 on Overweight and Obese Adults: A Randomized, Double-Blind Clinical Trial. The Korean Journal Family Medicine, 2013; 34: 80-89.

30. Sharafedtinov KK, Plotnikova OA, Alexeeva RI, Sentsova TB, Songiseppe Stsepetovaj, et al. Hypocaloric diet supplemented with probiotic cheese improves body mass index and blood pressure indices of obese hypertensive patients - a randomized double-blind placebo-controlled pilot study. Nutrition Journal, 2013;12: 138.

31. Park DY, Ahn YT, Park SH, Huh CS Yoo SR, Yu R, et al. Supplementation of *Lactobacillus Curvatus* HY7601 and *Lactobacillus Plantarum* KY1032 in Diet- Induced Obese Mice Is Associated with Gut Microbial Changes and Reduction in Obesity. PLOS ONE, 2013; 8 (3).

32. Cano PG, Santacruz A, Trejo FM, Sanz Y. *Bifidobacterium* CECT 7765 improves metabolic and immunological alterations associated with obesity in hight- fat- diet- fed mice. Obesity, USA, 2013; 21 (11): 2310- 2321.

33. Everard A, Matamoros S, Geurts L, Delminina NM, Cani PD. *Saccharomyces Boulardii* Administration Changes Gut Microbiota and Reduces Hepatic Steatosis, Low-Grade Inflammation, and Fat Mass in Obese and Type 2 Diabetic *db/db* Mice. MBio, USA, 2014; 5 (3).

34. Bomhof MR, Saha DC, Reid RT, Reid DT, Paul HA, Reimer RA. Combined effects of oligofructose and *Bifidobacterium animalis* on gut microbiota and glycemia in obese rats. Obesity, USA, 2014; 22 (3):763-771.

35. Nuñes IN, Galdeano CM, Leblanc Ade M, Perdigón G. Evaluation of imune response, microbiota, and blood markers after probiotic bactéria administration in obese mice induced by a high-fat diet. Nutrition, 2014; 30 (10-11): pg. 1423- 1432.

36. Hu X, Wang TAO, Wei LI, Feng JIN, Wang LI. Effects of NS *Lactobacillus* strains on lipid metabolism of rats fed a high cholesterol diet. Lipids in Health and Disease, USA, 2013; 9.

37. Lim SM, Jeong JJ, Woo KH, Han MJ, Kim DM. Lactobacillus

sakei OK67 ameliorates high-fat diet–induced blood glucose intolerance and obesity in mice by inhibiting gut microbiota lipopolysaccharide production and inducing colon tight junction protein expression. Nutrition Research, 2016; 36 (4): 337- 48.
38. Sanchez M, Darimont C, Drapeau V, Emady-Azar S, Lepage M. Rezzonico. Effect of Lactobacillus rhamnosus CGMCC1.3724 supplementation on weight loss and maintenance in obese men and women. British Journal of Nutrition, 2014;111: 1507– 1519.
39. Gomes AC. Efeito da terapia complementar com probióticos sobre a composição corporal e a atividade das enzimas antioxidantes de mulheres com excesso de peso. Sistema de Bibliotecas UFG. Dissertação (Mestrado em Nutrição e Saúde) - Universidade Federal de Goiás; 2014.
40. Lee SJ, Bose S, Seo JG, Chung YS, Lim CY, Kim H. The effects of coadministration of probiotics with herbal medicine on obesity, metabolic endotoxemia and dysbiosis: A randomized double-blind controlled clinical trial. Clinical Nutrition, 2014: 1-9.
41. Brahe LK, Chatelier LE, Prifti E, Pons N, Kennedy S, Faixa T, et al. Dietary Modulation of the Gut Microbiota- a Randomised Controlled Trial in Obese Postmenopausal Women. British Journal of Nutrition, UK, 2015; 114 (3): 406-417.

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