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ROLE OF PROBIOTICS IN PREVENTION OF OBESITY

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ABSTRACT:

Probiotics can be defined as live microorganisms that may beneficially affect the host upon ingestion by improving the balance of the microflora. It has various health benefits like alternation in weight, increasing the immunity, and also in digestion. Many of us would think that bacterial products aren't helpful but in contrast they are enormously useful. The common species involved are *Lactobacillus, Bifidobacterium*. At present the alarming issue for everyone might be weight gain. The probiotic diet helps in modification of gut microbiota and it inhibits the absorption of dietary fat and increases fat excretion via faeces. Most of the

attempts done to study the effects of probiotics with *Lactobacillus* strains on weight reduction was found to be positive. Probiotic administration on women over a period of three months had a significant reduction in weight compared to the pills. So probiotics are far better than artificially prepared pills. The aim of the review is to analyze whether a probiotic diet helps in reduction of weight and how far it could play the beneficial role in reduction of weight.

KEYWORDS: Bacteria; Gut microbiota; Obesity; Probiotics; Weight.

INTRODUCTION:

Probiotics are live microorganisms that are proposed to have medical advantage when directly consumed or applied over the body (Butel, 2014). Interestingly they can be found in yogurt, fermented foods, dietary enhancements or supplements and even beauty products. Often people think that all the microorganisms and the bacteria are harmful as they cause disease but actually many of them are helpful (Cohen, 2018). Certain bacteria help in digesting food, by destroying the disease causing cells and by producing vitamins. The microorganisms involved in the probiotic products are the same or more likely to be the microorganisms associated with our normal body (Didari *et al.*, 2014). They are used to treat certain conditions like irritable bowel syndrome, diarrhea caused by antibiotics and people also say that they have helped with certain skin conditions, preventing allergies and even oral health (Blaabjerg, Artzi and Aabenhus, 2017). Earlier these probiotics were used in the development of cattles and with Laurus nobilis, an essential oil enhances it (M, Geetha and Thangavelu, 2019). Interestingly the probiotics mouthwash is available which has an antibacterial effect (Elgamily *et al.*, 2018) in prevention of cariogenic bacteria so even these mouthwash can be used to keep the oral cavity clean. So rinsing the mouth can keep away the bacterial accumulation (Selvakumar and Np, 2017)(Shahana and Muralidharan, 2016).

Obesity is one of the major health problems whose prevalence is continuously increasing (Lean, 2010). This increase in body weight is associated with the development of certain diseases such as cardiovascular disease (Paramasivam, Priyadharsini and Raghunandhakumar, 2020), diabetes mellitus, even various cancer, When there is an unevenness between the energy intake and energy expenditure, it is considered to be the most important reason for obesity development (Bastien *et al.*, 2014). Not only this, there are several other factors like environmental, lifestyle factors and increased intake of fatty food and decreased physical movement are the most widely recognized conditions which favors obesity (Ngom-Bru and Barretto, 2012). Previously antibiotic treatment, novel vaccination(Pratha, Ashwatha Pratha and Geetha, 2017) etc were used in weight reduction. However in recent years, with the advancement of technology, attention has turned towards the gut microbiota (Jandhyala, 2015). This gut microbiota contains trillions of microorganisms and thousands of bacterial species. An attempt was made with the probiotics in altering the body weight.

The gut microbiota having a huge amount of microorganism plays specific functions in the host nutrient metabolism, drug metabolism, protection against pathogens, maintaining the structural integrity of the gut mucosal barrier (Hempel *et al.*, 2011). If there is any qualitative or quantitative change in the gut microbiota it can cause both intestinal and extra intestinal disorders (Principi *et al.*, 2018). When we compare gut microbiota composition in obese and lean individuals, they are different in both the cases, that modification of gut microbiota can be associated with an increased or a reduced body weight and BMI (Turnbaugh *et al.*, 2009). Based on these evidences, it can be considered that the gut microbiota with probiotics can be possibly used to prevent and treat obesity (Zhang *et al.*, 2018).

This review focuses about the gut microbiota and how it is associated with the change in weight. As these probiotics are used to treat and prevent obesity and its related problems, but still the problems associated with that are still discussed and debated. But on the other hand gut microbiota is gaining significant topics for research in relation to obesity, so this review will discuss the importance of probiotics and compared with the studies related to this issue.

Gut microbiota in weight loss:

The association between the gut microbiota and weight loss were initially carried out on animals. The research on mice which were germ free and where leaner than the animals which were conventionally raised (Backhed *et al.*, 2004). And importantly the gut microbiota composition of the obese mice was different from the other mice which was also given with the same diet (Ley *et al.*, 2005). These were studies done, where transplantation of gut microbiota from humans into those germ free mice was done. This study confirmed that the gut microbiota played a significant role in alerting the body weight (Ridaura *et al.*, 2013). There were attempts made to differentiate the gut microbiota composition in obese and lean individual.

The most commonly involved bacteria are *Lactobacillus and Bifidobacterium* in weight loss (Isolauri, Salminen and Ouwehand, 2004). The people who are associated with obesity have a lower bacterial count but the data when compared with animals and humans weren't the same (Turnbaugh *et al.*, 2006). There was evidence which didn't clearly tell that the given bacterial flora is completely a treatment for obesity. But certain useful species like *Bifidobacterium, Oscillospira, Alistipes, Erwinia,* are found to be more only in the normal weight when compared with that of the obese person (Murugesan *et al.*, 2015). The intestinal microbiota reduces the weight and with these probiotics, it helps in inhibiting the fat absorption and increases the fat excretion (Park and Bae, 2015). Earlier these probiotics were used as growth promoters in agriculture, which resulted in the modification of the gut microbiota in weight gain and even in weight loss (Angelakis, Merhej and Raoult, 2013). These gut microbiota functions to modulate the proliferation, differentiation of colonic epithelial cells during fermentation of non-digestible carbohydrates (Villanueva-Millán, Pérez-Matute and Oteo, 2015). And these probiotics not only manipulate the gut microbiota but also produce special antibiotics like substances which can kill harmful bacterial species. *Acinetobacter* species (Girija, Jayaseelan and Arumugam, 2018) (Priyadharsini *et al.*, 2018b), *Enterococcus (Marickar, Geetha and Neelakantan, 2014)* and *staphylococcus aureus*, and fungal species like *C.Albicans* are nosocomial pathogens which are responsible for post operative infection. Due to its multidrug resistance of these bacteria (Ashwin and Muralidharan, 2015)(Girija *et al.*, 2019)(Girija As and Priyadharsini J, 2019)(Smiline, Vijayashree and Paramasivam, 2018), and fungi (Shahzan *et al.*, 2019) when causing infection is difficult to evaluate (Priyadharsini *et al.*, 2018a). But these probiotic Bifidobacterium strains and natural products like orange peel (Vaishali and Geetha, 2018) are reported to have antimicrobial action against them.

Regulation of body weight:

The regulation of body weight by gut microbiota is done by three primary mechanisms which include short –chain fatty acid (SCFA) production, regulation of bile metabolism and protection from metabolic endotoxemia.

Short-chain fatty acid production:

The gut microbiota ferments the polysaccharides production into short chain fatty acid as a source of energy in omnivores (Flint *et al.,* 2008). These short chain fatty acids are found to be in greater concentration in faeces of obese person than with the normal weight. But not all the gut microbiota is capable of fermenting the non-digestible polysaccharide. On fermentation they produce Short chain fatty acids, acetate, propionate, butyrate (Macfarlane and Macfarlane, 2003) acetate production is more common whereas the propionate and butyrate are species specific and substrate specific. Butyrate has strong anti-inflammatory and anti-infective effects and it tends to prevent increased body weight and even provides improved insulin sensitivity (Guilloteau *et al.,* 2010).

Regulation of bile acid metabolism:

The deconjugation of bile acids by gut microbiota is done by the microbial enzymes. Lactobacillus produces an enzyme called as bacteria bile salt hydrolase which deconjugates the bile acids. This deconjugation process could be a protective one for certain bacteria like *Lactobacillus, Bifidobacterium* as they disintegrate the membranes (Mills, Martin and Elias, 1986). These deconjugated bile acids will be poorly absorbed in our body and most of which are excreted through faeces and this could be significant as this could reduce serum cholesterol level (Gu *et al.,* 2014). So this could play a major role in reduction of body weight.

Induction of metabolic endotoxemia:

The metabolic endotoxemia is an important innate immune response that has low grade inflammation because of increased circulating endotoxin. Increased plasma lipopolysaccharide levels are responsible for metabolic derangement which includes the metabolic endotoxemia (Raetz and Whitfield, 2002). When a study was conducted to analyse the relationship between high fat diet and its changes in gut microbiota and metabolic endotoxemia.The endotoxins producing bacteria Enterobacter cloace B29 which was isolated from an obese individual and when transferred in to a germ free mice on a high fat diet has developed obesity and insulin resistance. But the animals which were on a normal or low diet didn't have any metabolic changes((Fei and Zhao, 2013).

Studies in animals:

Studies in animals have shown that there was a significant reduction in weight but they were species specific (Li, Park and Zhu, 2011). The body weight modulation was found to be positive in relation to *Lactobacillus* species (Kim *et al.,* 2016). Most of the experiments conducted on animals gave a positive result on probiotics as an effective method of prevention and in the treatment of obesity. The probiotics was found to have influenced the body weight, fat, cholesterol levels, and glucose levels are altered but they are species specific (Arora *et al.,* 2012).

The most commonly studied species are *Lactobacillus* and *Bifidobacterium*. *Lactobacillus plantarum KY1032* and *lactobacillus curiatus HY7601* when introduced into mice either alone or with a combination for about 9 weeks, it was found that the mice has reduced fat accumulation in the liver and fat storing tissue(adipose tissue).Interestingly they showed a reduced cholesterol level and inhibits various genes related to fatty acid synthesis (Yoo *et al.,* 2013). On the other hand the Bifidobacterium species also showed significant change in

weight but even they were also species specific. A study was conducted among four strains of Bifidobacterium in a mice and the results were quite interesting as *Bifidobacterium L* 75-4,Fs31-21 had no change in the body weight, lipid and also glucose levels (Yin *et al.*, 2010). Whereas *Bifidobacterium* M13-4 showed an improved body weight but all four strains showed reduced levels of triglycerides. So there will be differences in the activities of both *Lactobacillus* and *Bifidobacterium.* But these studies have given a positive effect of probiotics in the animals for weight (Chen *et al.*, 2012). But the only difference is the dosage given which varies in each study so there wasn't uniformity in providing the dosage.

Studies in human beings:

Even in human beings the clinical trials were done and the commonly used species are *Lactobacillus* and *Bifidobacterium (Kadooka et al., 2010).* When *Lactobacillus rhamnosus* species was introduced into the pregnant women for 4 weeks and to the child till a duration of 6 months and it was observed that there was a significant weight reduction which lasted for about 4 years (Luoto *et al.*, 2010). During a clinical trial, *Lactobacillus acidophilus, Bifidobacterium lactis* with the probiotic yogurt was introduced into the people having Non-alcoholic fatty liver disease and it continued for about 8 weeks where there was a significant dropdown of serum levels of alanine transaminase (ALT), aspartate transaminase (AST), lactate dehydrogenase–C (LDL-C) compared to the control group (Nabavi *et al.*, 2014). When studies were conducted on children, there was a significant weight gain on probiotic administration, especially Lactobacillus species when compared to the control and a placebo control trail was conducted in 19 obese individual, where they are given with three packets of a mixture of few *Lactobacillus* species, *Bifidobacterium* species and Streptococcus thermophiles BT01 for about 16 weeks (Jones *et al.*, 2018). These adolescents who had taken probiotic courses for 16 weeks had a significant increase in weight and no effects in weight loss. So here in humans certain studies have shown weight gain on probiotic supplements but most commonly they are associated in weight loss.

Limitation:

Though probiotics have numerous health benefits, there are certain risk factors associated with this therapy. The risk factors are mainly concerned towards the immune compromised individuals, pregnant women, babies(Jankovic *et al.*, 2010). These probiotics can interact with other bacteria and can also directly have an impact on the host. They are also responsible for side effects like systemic infection, excessive immune stimulation, reduced metabolic activities (Musa *et al.*, 2009). Oxygen toxicity is also a major problem associated with the probiotic bacteria in dairy food. These high levels of oxygen cause harm to the viability of anaerobic bacteria (Thantsha, Mamvura and Booyens, 2012). And many of these bacteria die in the active culture during processing and some die during the passage to the intestine.

Recent studies:

Probiotics have been known to reduce the liver enzymes and used in the treatment of fatty liver disease (Eslamparast, 2014). The probiotic dietary supplements help to ferment both the diary food and non-dairy food which is not only used in the treatment of obesity but also in the treatment of diabetes and cancer. However the application is limited (Kerry *et al.*, 2018).

Probiotic soya milk produces an essential oil which has a positive effect in reduction of serum lipid levels in the rats which have diabetes (Mirlohi *et al.*, 2020).

CONCLUSION:

Probiotics plays a significant role in reduction of body weight especially the *Lactobacillus* strains have a significant role. The intestinal flora is maintained and also provides a dual support in stabilizing the body health, immunity, and digestion. The probiotic diet provides a greater weight change in both obese and non-obese individuals. It not only promotes weight loss but also helps to maintain immunity by promoting the growth of healthier microbiota. There are chances that our food could alter the gut microbiota so the healthier food we eat the more benefit it provides to our body. So instead of antibiotic treatment administration of probiotics can be used as an alternative in reducing the weight. Conventionally these antibiotic treatments, novel vaccination was used in weight reduction but the awareness of probiotics still must be improved due to its beneficial activities. So even awareness must be created for proper vaccination and everyone must get one.Probiotics are safe and are a healthy alternative to antibiotic administration, which can be prescribed for weight loss in human beings. But there are contradictory studies which prove that probiotics results in weight gain in human beings. So further research can be done to confirm the use of probiotics as a prescribed regimen for weight loss.

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