

Mini Review on the Dynamic Probiotic-*Bacillus coagulans*



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Abstract

The health conscious consumers have started understanding and gravitating towards probiotic consumption for the rise in documented health benefits they impart on the hosts. Digestive well-being is the global obsession among the rapidly aging population. Amongst the many probiotic bacteria and yeasts available, *Bacillus coagulans* is one of the most robust spore forming probiotic which is in high demand by the commercial producers for several technological advantages. This mini review enlists the reported health effects exerted by this dynamic probiotic- *B. coagulans* and also commercial formulations containing them.

Keywords: *Bacillus coagulans*, Probiotics, Commercial production.

Introduction

Health benefits imparted by probiotics and their roles in maintaining health and disease prevention has been an area of extensive research in the past few decades. Some of the commonly used probiotics include *Lactobacillus rhamnosus*, *L. reuteri*, *Bacillus coagulans*, *E. coli* Nissle 1917, some *enterococci* and yeasts like *Saccharomyces boulardii* etc. Pandey et al. [1] have reviewed the major health benefits (and their probable mechanisms of action) ranging from diarrhea to cancer prevention etc. One of the nastiest technological problems probiotic fermentation industries face is loss of viable cell count during harsh processing conditions. Spore forming *Bacillus* probiotics remain in huge demand due to their ability to withstand the stringent processing conditions. One of the sturdiest probiotics is *B. coagulans*.

Bacillus coagulans

Bacillus coagulans (discovered in 1930) was formerly known as *Lactobacillus sporogenes*. *B. coagulans* is a spore forming non-pathogenic gram positive bacteria that produces L(+) lactic acid homofermentatively. *B. coagulans* is a remarkably resilient probiotic that is able to withstand extreme conditions (like high temperatures, processing, stomach acids and bile) and is room temperature-stable for up to 3 years. Sporulation property makes *B. coagulans* the favorite of commercial probiotic producers. Various preparations of *B. coagulans* in powder, tablet and capsule forms exist in the market imparting several health benefits on the hosts like treatment of prevention of some diseased conditions (some are enlisted in Table 1).

Table 1: Health benefit.

Health benefit	Reference
Prevents muscle damage during exercise	Jäger et al.[6]
Gastrointestinal disorders like IBS and IBD	Majeed et al. [8]
Different types of diarrhea like Antibiotic associated and travellers diarrhea)	Majeed et al. [7]
Colitis (induced by <i>Clostridium difficile</i>)	Fitzpatrick et al. [4]
Cadmium and mercury poisoning	Jafarpour et al. [5]
Hypercholesterolemia	Abhari et al. [2]
Gut functions improvement in elderly population	Nyangale et al. [9]
Treating rheumatoid arthritis	Abhari et al. [2]
Poultry (boosting immunity & growth enhancement)	Park et al. [11]
Preventing bacterial vaginosis	Sudha et al.[12]
Cancer prevention	Azimirad et al. [3]

Global Probiotic Market

The penetration of probiotics in the market is very high. Probiotic foods are available in grocery stores and supermarkets, while probiotic supplements are available in pharmacies and health food shops. Moreover, the increasing obsession of digestive wellbeing and preventive healthcare has accelerated the market growth. There is increase in number of probiotic ingredient suppliers who develop tailored strains of microorganisms for integrating with a diverse set of probiotics products.

Dynamic Probiotic for Commercial Producers

The probiotic ingredients market is segmented on the basis of application into food & beverage (dairy, bakery & confectionery, meat & cereals, etc), dietary supplements, and animal feed. The global probiotic market is dominated by players like Yakult (Japan), Dupont (Danisco), Ganeden (USA), Sabinsa (USA), BioGaia (Sweden), Nestle (Switzerland) etc. Asia-Pacific is the largest market for probiotic products and ingredients with Japan having accounted for a major share. The dietary supplement segment is projected to grow at the highest CAGR of 8.0% from 2015 to 2020. Health effects exerted by any probiotic is strain specific. Some of the commercial formulations containing *B. coagulans* strains have been enlisted below Table 2.

Table 2: Commercial probiotic formulations containing *Bacillus coagulans*.

Product	Strain	Manufacturer
Staimune	<i>B. coagulans</i> GBI-30, 6086	Ganeden (USA) https://www.ganedenprobiotics.com/probiotic-news/news/ganeden-receives-fda-gras-on-probiotic-derived-immune-health-ingredient-sta
Sporlac R (for aphthous stomatitis)		Sanzyme (Japan) http://sporlac.com/prodsporlac-Ds.aspx Suja Probiotics (USA)
Pineapple probiotic enhanced water		https://www.sujajuice.com/products/pressed-probiotic-waters/pineapple-lemon-cayenne/
Radical ranch crunchy probiotic kale	<i>B. coagulans</i> GBI-30	Brad's plant based https://bradsplantbased.com/shop/crunchy-kale/crunchy-kale-radical-ranch-wprobiotics-12-pack/
Enjoy Life Pancake+waffle mix	<i>B. coagulans</i> GBI-30	Enjoy https://enjoylifefoods.com/our-food/baking-mixes/pancake-waffle-mix/
Nutty delight museli	<i>B. coagulans</i> SNZ 1969	INDIA https://www.probiotaevent.com/wp-content/uploads/2017/02/Emma-Schofield-Probiota-2017.pdf
NurtureMe	<i>B. coagulans</i>	Ganeden (USA) https://nurturme.com/
proDURA	<i>B. coagulans</i>	MayPro (Japan) http://maypro.com/products/produra#_ednref1
Lactospore	<i>B. coagulans</i> MTCC 5856	Sabinsa (USA) http://www.lactospore.com/

Conclusions

B. coagulans strains need a further characterization to rule out the speculations like causative agent for infections in patients with catheters and leading to rejections in organ transplants etc. Another lacunae in *B. coagulans* research is lack of large scale human trials and uncertainty of dosage amounts due to scanty clinical data. There is a need to evaluate the survival of *B. coagulans* during manufacturing process and storage conditions [2-12].

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