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Growth effects of lactic acid bacteria in the presence of *Spirulina platensis*

Ashok Kr Singh
Principal, SRTC PG College Utraula Balrampur, Uttar Pradesh, India

Abstract
The *Spirulina platensis* is filamentous cyanobacteria known as blue green algae which aften used as single cell protein. The extracted biomass of *Spirulina platensis was* studied on lactic acid bacteria grown in milk. The addition of 10 mg S*pirulina platensis* into milk stimulate the growth of lactic acid bacteria. These are hecterogenous group of bacteria which play a significant role in variety of fermentation process.

Keywords: *Spirulina platensis*, lactic acid bacteria, dried skimmed milk, growth factors

Introduction
The lactic acid bacteria involves food agriculture and clinical application. They are gram positive non sporing non respiring which producing lactic acid the major end product during fermentation of carbohydrates (Khalid 2011 and Caggia *et al* 2015) [7, 11]. The fermented milk contribute to health natural nutrients and enrich the intestinal flora with lactic acid bacteria. They provide protection from infection stimulates immune system as well as better digestion and absorption of lactose and minerals (Ashraf *et al* 2014 and Hayek *et al* 2013) [10, 6]. This micro algae conation essential amino acid, protein, fatty acid, antioxidant pigments, caretenoids, beta carotene and phycocyanin. It can be used as treatment of nervous system and metabolism including weight loss and high cholesterol. Spirulina sp is best known genus of cyanobacteria which used as human food (Fox 1986) [1]. It contain heigh quality protein about 18 known amino acid, more vitamins A, E K, B1, B2, B6, and all essential minerals, trace element and enzymes. It is richest source of calcium, phosphorus, iron, potassium, sodium and fatty acid (Parada *et al* 1998) [4].

Materials and methods
Culture Media
The Zarrouk culture medium was prepared for *Spirulina platensis* (Zorrouk 1996) The lactic acid bacteria *Streptococcus thermophilus, Pediococcus acidilactici* and *Lactobacillus acidophilus* grown on MRS both agar media using Nestle dried skimmed milk (Till 2014) [8].

Experimental Process
The *Spirulina platensis* was cultured in Zorrouk medium at 28 ^{o}C. The cultured reached at stationary phase then the biomass was separated by the fillteration and washed with acid water up to pH 7. The biomass was dried and made powder. The suspension was prepared in 0.1 M phosphate buffer pH 5.5 and kept in refrigeration for 2 hours. The lactic acid bacteria grown on MRS broth medium were culture at 37 ^{o}C in suspension of *Spirulina platensis* to final concentration of 10 mg at pH 5.5. The control was prepared without addition of *Spirulina platensis*. The sample was taken at different period of time to establish the growth kinetics by counting colonies on MRS agar medium. The results were expressed as colony forming unit (cfu) per ml.

Result and Discussion
The lactic acid bacteria grown from MRS both agar medium as shown in Figure 1, 2 and 3. The effect of lactic acid bacteria growth were observed with and without addition of *Spirulina platensis* at pH 6.5. The growth factor for *Streptococcus thermophilus, Pediococcus acidilactici* and *Lactobacillus acidophilus a*t two hours with and without *Spirulina platensis* was probably similar and after reaching at 8 hours the growth increases due to decrease in the amount of stimulatory factors. The strain reached the stationary phase after 12 hours and counting remain same up to 14 hours. The same strain without addition of *Spirulina platensis* grow more slowly and continue up to 14 hour reaching the same value as shown in Table 1. The tested lactic acid bacteria showed more growth in milk enriched with natural nutrition turn the *Spirulina* and responded to different extent according to strain. Prada *et al* 1998 founded that addition of extra cellular product obtained from late log phase culture of *Spirulina platensis* promoted the growth of some lactic acid bacteria. Gibsom and Roberford 1995 [2] suggested that *Spirulina platensis* have stimulatory effect on growth of lactic acid bacteria. Henriksen 1994 [3] describe the chemical nature and combination of *Spirulina platensis* which have additional contribution to the lactic acid bacteria. The dry mass of *Spirulina platensis* contributed vitamin, phosphorous, iron according to the chemical composition given by Richmond 1999. Now a days when the dairy industry supplemented milk with mineral, vitamins, antioxidant it would be we consider possible adding of *Spirulina platensis* biomass. The natural product to fermented milk to induce the faster production of lactic acid bacteria and increase the number of vible cells in the products.
The *Spirulina platensis* is very effective to increase growth milk bacteria and useful for dairy industry.

Fig 1: *Streptococcus thermophiluss*

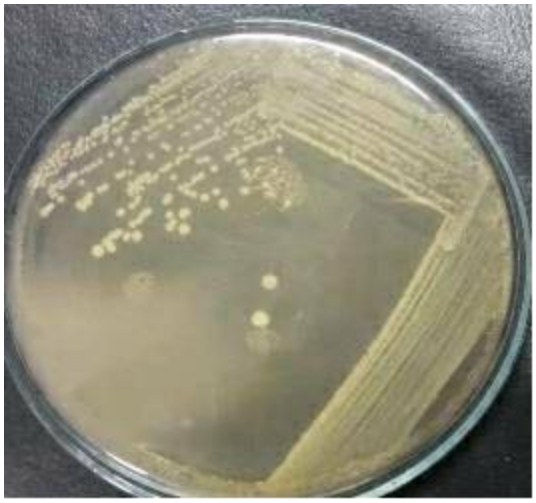

Fig 2: Pediococcus acidilactici

Fig 3: *Lactobacillus acidophilus*

Table 1: Growth kinetics of lactic acid bacteria with and without additional of *Spirulina platensis.*

Lactic acid bacteria	Time				
	Zero hour	Two hours	Four hours	Eight hours	Twelve hours
Streptococcus thermophilus	5.251	5.452	6.112	7.810	8.100
Streptococcus thermophilus and Spirulina platensis	5.251	5.527	7.211	8.991	9.102
Pediococcus acidilactici	5.811	5.991	6.221	6.880	6.891
Pediococcus acidilactici and Spirulina platensis	5.811	6.000	7.188	7.810	7.991
Lactobacillus acidophilus	5.921	6.101	6.821	7.011	7.281
Lactobacillus acidophilus and Spirulina platensisz	5.921	6.111	7.165	8.810	8.110

- Growth measured in colony forming unit/ml (cfu/ml).
- The plus and minus data variation is possible.

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