Inclusion Of *Lycium barbarum, Psidium guajava, Momordica grosvenori* And *Garcinia mangostana* In Yogurt And Their Effects On Fermentation And Exopolysaccharide-Production

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ABSTRACT

Yogurt is popularly consumed because of its high digestibility, refreshing organoleptic properties and the healthy bacteria it contains. Milk incubated with starter culture (SC) at 41°C in the presence of plants (*Momordica grosvenori, Psidium guajava, Lycium barbarum* or *Garcinia mangostana*) water extract were studied to examine the effects on acidification, microbial growth, gelation and exopolysaccharide (EPS) content. Initial pH values (5.8-6.2) of the mixture of milk, plant water extract and SC were not different ($p>0.05$) from control (6.20; mixture of milk and SC). The rates of pH reduction for all herbal-yogurts (-0.40 pH unit/ hour), except *G. mangostana* and *M. grosvenori* (-0.33 and -0.32 respectively pH unit/hr) was similar to control (-0.43 pH unit/ hr) during the first 4 hours of incubation. Microbial mass increased for both *Lactobacillus* spp. and *Streptococcus thermophilus* in the presence of plant water extracts at 0.75%, 1.5% and 3% (w/v). *Lactobacilus* spp. counts in *L. barbarum-, P. guajava-* and *M. grosvenori-* yogurts (1.52, 1.32 and 1.23×10^6 cfu/ ml, respectively, $p>0.05$) with the exception of *G. mangostana-* yogurt (0.69×10^6 cfu/ml; $p>0.05$) were higher compared to control (1.01×10^6 cfu/ ml). The *S. thermophilus* counts in *L. barbarum-, P. guajava-* and *M. grosvenori-* yogurts (785, 1045 and 805×10^6 cfu/ ml respectively, $p>0.05$) with the exception of *G. mangostana-* yogurt (610×10^6 cfu/ml; $p>0.05$) were higher than that in control (615×10^6 cfu/ ml). The EPS content in *G. mangostana*-yogurt (113.1 µg/ ml, $p>0.05$) was lower whereas *L. barbarum-, P. guajava-* and *M. grosvenori-* yogurts (181.4, 258.7 and 183.9 µg/ ml respectively, $p<0.05$ for *P. guajava* -yogurt only) were higher than control (132 µg/ ml). Syneresis (S) was increased in *P. guajava-* but decreased in *G. mangostana*-yogurts (3.61 and 2.90% respectively; $p>0.05$) whereas water holding capacity (WHC) was reduced in *P. guajava* (22.8%; $p>0.05$) but increased in *G.*

mangostana (28.1%; $p<0.05$) compared to control (S= 3.23%, WHC= 24.1%). In summary, the presence of plant water extracts affected yogurt fermentation by modifying of yogurt bacteria growth and metabolism which resulted in the enhancement of acidification of yogurt.

ABSTRAK

Yogurt popular dimakan kerana penghadaman yang tinggi, sifat-sifat organoleptik yang menyegarkan dan bakteria sihat yang dikandunginya. Susu dieram dengan kultur pemula (SC) pada 41^{0}C di dalam kehadiran ekstrak air tumbuh-tumbuhan (*Momordica grosvenori, Psidium guajava, Lycium barbarum* atau *Garcinia mangostana*) telah dikaji bagi meneliti kesan pada pengasidan, pertumbuhan mikrob, pengentalan dan kandungan eksopolysakarida (EPS). Nilai-nilai awal pH (5.8-6.2) campuran susu, ekstrak tumbuhan air dan SC tidak berbeza (p> 0.05) daripada kontrol (6.20; campuran susu dan SC). Kadar pengurangan pH untuk semua yogurt herba (-0,40 pH unit/ jam), kecuali *G. mangostana* dan *M. grosvenori* (-0,33 -0,32 masing-masing pH unit/ jam) adalah sama untuk kontrol (-0,43 pH unit/ jam) dalam tempoh 4 jam pertama pengeraman. Jisim mikrob meningkat bagi kedua-dua *Lactobacillus spp.* dan *Streptococcus thermophilus* dalam kehadiran ekstrak tumbuhan air 0.75%, 1.5% dan 3% (w / v). Kiraan *Lactobacilus spp.* dalam yogurt *L. barbarum, P. guajava* dan *M. grosvenori* (1.52, 1.32 dan 1.23 × 10^{6} CFU / ml masing-masing, p> 0.05) kecuali yogurt *G. mangostana* (0.69 × 10^{6} CFU / ml; p >0.05) adalah lebih tinggi berbanding kontrol (1.01 × 10^{6} CFU / ml). Kiraan *S. thermophilus* dalam yogurt *L. barbarum, P. guajava* dan *M. grosvenori* (785, 1045 dan 805 × 10^{6} CFU / ml masing-masing, p> 0.05) kecuali yogurt *G. mangostana* (610 × 10^{6} CFU / ml; p >0.05) adalah lebih tinggi berbanding kontrol (615 × 10^{6} CFU / ml). Kandungan EPS dalan *G. mangostana*-yogurt (113.1 μg / ml, p> 0.05) adalah lebih rendah manakala *L. barbarum, P. guajava* dan *M. grosvenori*-yogurt (181.4, 258.7 dan 183.9 μg / ml masing-masing, p <0.05 untuk *L. barbarum*-yogurt sahaja) adalah lebih tinggi daripada kawalan (132 μg/ ml). Syneresis *P. guajava* meningkat tetapi menurun bagi *G. mangostana*-yogurt (3.61 dan 2.90% masing-masing; p> 0.05) manakala kapasiti menahan air (WHC) telah berkurangan bagi *P. guajava* (22.8%; p> 0.05) tetapi meningkat bagi *G. mangostana* (28.1%; p <0.05) berbanding kontrol (S = 3.23%, WHC = 24.1%). Kesimpulannya, kehadiran ekstrak air mempengaruhi fermentasi yogurt melalui pengubahsuaian pertumbuhan dan metabolisma yogurt bakteria yang menyebabkan peningkatan pengasidan yogurt.

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LIST OF ABBREVIATIONS

% = percentage

°C = Degree Celcius

& = and

etc = et cetera

i.e = for example

vs = versus

min = minute(s)

mg = milligram(s)

L = liter (s)

ml = milliliter(s)

µl = microliter(s)

g = gram (s)

µg = microgram(s)

m = meter

nm = nanometer

Da = Dalton

Wt = weight

V = volume (s)

N = normality (s)

Min = minute (s)

Hr = hour (s)

EPS = exopolysaccharides

LAB = lactic acid bacteria

dH_2O = distilled water

TCA = trichloroacetic acid

HCl = hydrochloric acid

NaOH = sodium hydroxide

TTA = Titratable Acidity

WHC = water holding capacity

CFU = Colony forming unit

OD = optical density

Tr cell = T regulatory cell

Th cell = T helper cell

TNF = Tumor necrosis factor

IL-6 = Interleukin-6

SD rats = Sprague Dawley rats

SSUV = solar-simulated Ultraviolet

GML = Garcinia mangostana Linn

DMH = 1,2-dimethylhydrazine

S. thermophillus = *Streptococcus thermophilus*

G. mangostana = *Garcinia mangostana*

L. barbarum = *Lycium barbarum*

M. grosvenori = *Momordica grosvenori*

P. guajava = *Psidium guajava*

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