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A Comparative Study to develop calcium, zinc and antioxidant rich drinking yoghurts using plant and pharmaceutical sources

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Figure 1: *Moringa oleifera*

Figure 2: *Phyllanthus emblica*

ABSTRACT

In this study, the effect of fortification of aqueous extracts of ***Moringa oleifera*** dried leaf powder and ***Phyllanthus emblica*** fresh fruit as plant ingredients and **calcium carbonate** and **zinc aspartate** from Unizink® 50 capsule as pharmaceutical ingredients in drinking yoghurts was investigated. The aim was to manufacture drinking yoghurts, which fulfill 1/3, 1/2 and 2/3 of Recommended Dietary Intake of calcium and zinc in humans and enrich with antioxidants. Mineral analysis and sensory evaluations of the products were carried out to select the best product from both plant and pharmaceutical product series. As analysed, calcium content of *Moringa* leaf extract prepared from unblanched leaf powder (25.27± 0.25mg/ml) was higher than from blanched leaf powder (17.14± 0.01mg/ml). In the mineral analysis, calcium contents of the drinking yoghurts analysed using wet ashing method were comparatively higher than the values obtained from dry ashing method. Sensory evaluation provided that drinking yoghurt fortified with plant ingredients at 50% RDI of calcium was the best sample ($p<0.05$). The total phenolic content of the best product was 3.17 mg GAE/g and ascorbic acid content was 55.5mg/100g. The DPPH radical scavenging activity (Antioxidant activity) was higher in plant ingredient fortified drinking yoghurts than with pharmaceutical ingredients ($p<0.05$). During the shelf life evaluation, there was no significant difference in total plate count of both fortified drinking yoghurt categories compared to the plain drinking yoghurt (control) but drinking yoghurt fortified with pharmaceutical sources showed higher pH values than the plain and plant ingredient fortified drinking yoghurts. Whey syneresis was higher in drinking yoghurts fortified with plant extracts and the viscosity decreased with the incorporation of plant extracts. The above plant ingredients can be successfully fortified at the level of 50% RDI of calcium while pharmaceutical ingredients at 33% RDI of calcium and zinc in drinking yoghurts with best sensory characteristics.

GENERAL OBJECTIVE

To develop drinking yoghurt for health conscious people and vegetarians, fortified with nutrients deficient in a typical vegetarian diet.

METHODOLOGIES

Description	Methodology
1. Preparation of drinking yoghurts	- As plant sources ***Moringa oleifera*** **dried leaf powder extract** and ***Phyllanthus emblica*** **fruit extract** were added. As pharmaceutical sources ; **zinc aspartate** from Unizink® 50 capsule and **food grade calcium carbonate** were added.
2. Mineral analysis	- Ca and Zn contents in plant extracts using wet ashing method (Kaya, Akdeniz and Yaman, 2008)with minor modifications. - Ca, Zn, Na, K, Mg and Fe contents in products using wet ashing method (Kaya, Akdeniz and Yaman, 2008)with minor modifications. - Ca content in products using dry ashing method (AOAC 2003)
3. Sensory evaluation	Descriptive analysis using semi trained and trained panelists.
4. Total phenolic content (TPC)	Folin-Ciocalteu's reagent method (Ainsworth and Gillespie, 2007)
5. Antioxidant activity	DPPH radical scavenging activity (McCue and Shetty, 2005) with minor modifications.
6. Ascorbic acid content	Titrimetric method of 2, 6 dichlorophenol indophenol dye (AOAC Method 967.21)
7. Physico- chemical properties	The total solid content, moisture content and ash content (AOAC 2005); protein content using kjeldhal method (AOAC 2000); fat content using Gerber method (Kleyn *et al.,* 2001)
8. Shelf life evaluation	Organoleptic properties, pH (pH meter, Eutech 510), titratable acidity (AOAC 1990) were tested within intervals throughout the shelf life. The syneresis was determined according to the centrifuge method described in Hassan *et al.,* 2015.
9. Microbiological evaluation	The count of coliform (ISO 4831:2006) using MPN method, yeast and mould (ISO 6611:2004) and total plate count (ISO 4833:2003)
10. Statistical evaluation	MINITAB 17 statistical software

RESULTS AND DISCUSSION

Table 1:Mineral composition of final products (1 cup = 170g of drinking yoghurt)

Sample	Ca mg/ cup ± SD	Zn mg/ cup ± SD	Mg mg/ cup ± SD	Fe mg/ cup± SD	Na mg/ cup± SD	K mg/ cup± SD
P33%	311.50± 0.04	3.04± 0.05	182.69± 0.69	6.38± 0.09	180.74± 0.40	255.55± 1.75
P50%	451.65± 0.66	4.95± 0.00	266.58± 0.89	10.09± 0.03	217.67± 0.76	236.83± 0.22
P66%	630.82± 1.40	5.36± 0.34	431.18± 0.72	12.72± 0.31	234.61± 0.12	229.77± 2.21
Control	129.75± 0.71	0.43± 0.00	181.13± 0.42	3.41± 0.07	172.21± 0.14	198.25± 1.20
M 33%	283.64± 0.11	0.89± 0.00	181.31± 0.62	3.54± 0.07	125.35± 0.43	217.42± 5.81
M 50%	434.99± 3.36	1.56± 0.00	183.38± 0.17	5.64± 0.28	170.40± 0.24	204.62± 0.83
M 66%	514.45± 1.28	2.17± 0.06	186.14± 0.81	8.68± 0.21	169.75± 2.22	210.48± 0.05

(Mean values of n=3 ± Standard Deviation. P33%, P50% and P66% in the table denote the pharmaceutical ingredients added drinking yoghurts made fortified with 33%, 50% and 66% RDI levels of calcium and zinc respectively. 'Control' indicates the plain drinking yoghurt. M 33%, M 50% and M 66% denote drinking yoghurts fortified with plant extracts at 33%, 50% and 66% RDI levels of calcium respectively).

According to the sensory evaluation, M50% was selected as the best sample.M 50% sample which was selected as the best product in the sensory analysis, had increased the TPC from 1.34 mg GAE/g to 3.17mg GAE/g. Consumption of one cup (170mL) of M50% drinking yoghurt, would provide 538.9mg of GAE (Gallic acid equivalents).

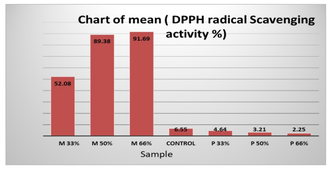

Figure 3: Antioxidant activity

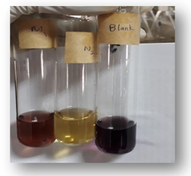

Figure 4: Colour change In plant extracts compared to the control when react with DPPH reagent.

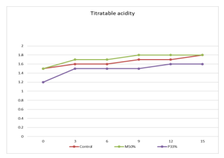

Figure 5:Titratable acidity

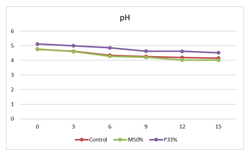

Figure 6: pH

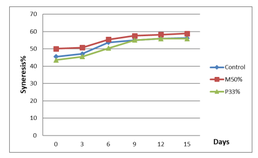

Figure 7: Syneresis

Table 2: Ascorbic acid

Sample	Ascorbic acid content mg/100g
Phyllanthus emblica fruit extract	66.60± 0.00
Moringa oleifera leaf extract	16.65±0.00
Control	5.55±0.00
M50%	55.50±0.00

Table 3: Proximate composition of the best product compared to the control drinking yoghurt

Constituents%	M 50% RDI	Control
Fat	2.20± 0.03	2.5±0.00
Protein	4.68± 0.00	3.58± 0.02
Moisture	87.14± 0.07	79.56± 0.03
Ash	1.04± 0.01	0.57± 0.00
Total Solid content	18.54± 0.01	20.30± 0.01
Total soluble solid content	17.00± 0.00	18.00± 0.00

CONCLUSION

The above plant ingredients can be successfully fortified at the level of 50% RDI of calcium while pharmaceutical ingredients at 33% RDI of calcium and zinc in drinking yoghurts.

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