Asian Jr. of Microbiol. Biotech. Env. Sc. Vol. 24, No. (4) : 2022 : 762-766

ISSN-0972-3005

DOI No.: http://doi.org/10.53550/AJMBES.2022.v24i04.024

STORAGE STUDIES OF FUNCTIONAL YOGURT DRINK MADE WITH MEDIUM CHAIN TRIGLYCERIDE OIL AND ITS QUALITY ATTRIBUTES

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(Received 26 June, 2022; Accepted 20 August, 2022)

Key words : *Medium chain triglyceride, Fortification, Yogurt, Storage study, Sensory*

Abstract – Medium chain triglyceride oil based functional yogurt drink was prepared from skim milk with the addition of MCT at two different variations (0.5 and 1.0%) and transferred to a sterilized glass bottle with skimmed milk at (43 °C). The pH and TSS values of yogurt decreased over the storage period with a simultaneous increase in bacterial count. The sample with concentration of 1 % of MCT treated at 43 °C showed the best results compared to control samples with an acceptable microbial load. The highest lightness index was found in MY2 with 82.30 and lowest was in MY1 with 80.5 at the 1st day of the storage. At the end of the storage period (21st day), decreased lightness (L*) was observed in MY1 followed by control sample. TA was significantly increased in MYC than in MCT samples with value of 1.11±0.11% and 1.10±0.10% respectively. Acceptability index of sensory attributes of developed yogurt drink of 1 % MCT oil incorporated shows the best overall acceptability compared to other samples. Hence it is a potential replacement to the probiotic drinks with added health benefits.

INTRODUCTION

Consumers are more knowledgeable about the nutritional elements of many food products today. Customers desire nutritious cuisine that is also easy to prepare and consume. The majority of people who are concerned about their health are increasingly choosing healthier food options. As a result, the inclusion of MCT, which has the dual qualities of MCFA and long chain triglyceride (LCT), enhances the nutritional content of food products. Most persons on modified diets who need nutritional enrichment and patients recovering from sickness or injury can benefit from nutritional goods (Osborn *et al.,* 2003). Numerous dietary supplements are available that can be taken with meals or in between them as a significant source of nourishment.

One of the key areas of study in the field of lipid sciences is MCFA that is composed of MCT and MLCT and contains structured lipids. Compared to traditional oils and fats, MCT and MLCT have been demonstrated to exhibit superior physiological benefits with numerous functions. A number of researches suggested that consuming MLCT and MCT could prevent the body from storing visceral fat while also acting as a quick source of energy that is different from sugar (Nagao and Yanagita, 2010). Given the significance and necessity of dietary oils and fats for the production of energy, fat-soluble vitamins, and essential fatty acids, the health advantages offered by MLCT and MCT are crucial, especially in the fight against the prevalence of metabolic diseases like obesity, CVD, and diabetes that are brought on by dietary oils and fats overconsumption. MCTs resemble ordinary vegetable or animal oils and fats in that they seem flavourless, colourless, and have no odour(Lee *et al.*, 2021).

As popular fermented dairy product, yoghurt

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contains proteins that have been coagulated by lactic acid-producing bacteria (Ghoneem *et al.,* 2018). Yogurt is chosen by most customers over ordinary milk because of its easily digestible protein, availability of probiotics, and bioavailability of a number of minerals and vitamins. It is helping customers by lowering levels of -glucuronidase and other carcinogens, safeguarding bowls from inflammatory disorders, and preventing allergies. (Fazilah *et al.,* 2018). Most of health awareness consumers are now switching towards healthier options of food products. The advantages of medium chain triglycerides (MCT) for health are getting a lot of attention. MCT aids in boosting the immune system, lowering cholesterol, restoring nutritional balance, and lowering the risk of cancer (Akoh and Kim, 2008).

In their (2007) study, Nielsen, Debnath, and Jacobsen examined the oxidative stability of yoghurt enhanced with fish oil following the addition of antioxidants such vitamin K, citric acid ester, and EDTA. Yogurt was found to be stable at 5° C for 19 days according to sensory evaluation and peroxide value tests. The addition of an antioxidant extended the stability to 29 days. When combined with structured triacylglycerides, the antioxidant EDTA has been shown to improve the stability of milk drink-type emulsions (Timm-Heinrich *et al.,* 2003).

Therefore, the present study was undertaken to developa functional yogurt drink fortified with medium chain triglyceride oil (MCT's) and study its storage stability under refrigerated condition.

MATERIALS AND METHODS

Raw materials

MCT oil has extracted from virgin coconut oil. Skim milk with protein (3.5%) and fat (0.2%) was procured from the local market, Thanjavur. Combination of *Streptococcus thermophiles*, *Lactobacillus cremoris* and *Lactobacillus bulgaricus* (1:1:1) starter culture were purchased from M/s. Alla's Posh Flavours, India. All the chemicals were purchased of analytical grade from HiMedia Laboratories Pvt. Ltd, India

Experimental methodology

To 100 ml of pasteurized milk 0.25 g of mother culture was added and kept under refrigerated condition. The low- fat skimmed milk was used to prepare yogurt drink; first the milk was pasteurized under double boiling method at 80 °C for half an hour then cooled down at 45 °C. To each glass bottle contains 50 ml of pasteurized milk, sugar and 1 ml yogurt culture (*S. Thermophillus* and L. *Bulgaricus)* was added. Then incubated for 5 hrs at 43±1°C. Further, 1 % of MCT oil were incorporated to each sample and homogenized for 3 minute at 8000 rpm, cooled down and store in refrigerator for further storage analysis.

Storage studies

The physio-chemical and microbiological properties of MCT incorporated yogurt samples were determined at time intervals of 0, 7, 14 and 21 days during storage period. In this study,colour, pH, TSS, TA, Total plate count and syneresis rate and sensory analysis were determined

Colour parameters

Colour was measured using ColorFlex to determine the L* ofthe colour intensity of each yogurt sample was determined.

pH and TSS

pH of yogurt was determined by using digital pH meter (King's lab, Model; KLPHM-114).5 ml of yogurt sample was placed in measuring cup of the pre-calibrated pH meter and analyzed at room temperature and the samples were read in triplicates. TSS measurement of prepared yogurt drink was taken 2 drops of sample was placed in hand held digital refractometer which directly shows the reading and is expressed in pBrix

Titrable acidity

10 ml of yogurt shake samples was measured and poured to conical flask and add same amount of distilled water (10 ml), next 2-3 drops of phenolphthalein indicator was added to sample and titrated against 0.1 N NaoH. The process is stopped when the sample mixture turns pink which lasted for 5 sec then the acidity was calculated according to the percent of lactic acid (Almasi *et al.,* 2021)

$$\text{Acidity (\%)} = \frac{(N \times 0.005 \times 100)}{w} \qquad .. (1)$$

Whereas, N- is ml of consumed NaoH; V- sample volume

Total plate count

Determination of total plate count gives an account about the bacterial load in the developed products. From the serial dilution (10^6), 0.1ml of the sample

were spread plated into sterilized Petri plates containing 15 ml of molten nutrient agar. Triplicates plates were incubated at 37 °C for 72h. Results were expressed in CFU per ml of sample products.

Syneresis

Syneresis gives an account of whey separation from solid mass and the extent of resistance of MCT's incorporated in skim milk yogurt. Ten grams of samples were taken in a centrifuge tube and were centrifuged at 4 °C for 0, 3, 6, 9, 12 and 15 min at 1200 rpm (Model-E-Spin Lark Make). The whey separated from the supernatant was quantified with a measuring cylinder. Following, formula was used for the determination of serum isolation rate (Sah BNP *et al.*, 2016)

$$SSR = v2–v1/v1 \times 100 \quad .. (2)$$

Where v1 is the volume of the sample and v2 is the volume of serum separated.

Acceptability index

Acceptability index of the yogurt drink incorporated with MCT oil was determined by following equation (Lafarga *et al.*, 2019).

$$AI = Lowest\ score/Highest\ score) \times 100 \quad .. (3)$$

Statistical analysis

All experiments were conducted in triplicate and the data are expressed as means ± standard deviation (SD) of three independent experimental runs. Duncan's multiple range tests with P value< 0.05 was performed with IBM SPSS Statistics software version 20 (IBM, USA) to verify the significance of all tests.

RESULTS AND DISCUSSION

Color analysis

Color is a significant attribute in food since it is the first characteristic observed by customers and hence frequently determines their preference (Vénica *et al.*, 2020). The given Fig. 1 shows the lightness (L*) of fortified yogurt drink with or without MCT oil stored at 4 °C for 21 days' storage period. The color index was slightly ($P \leq 0.05$) shifted with its addition and slightly reduced with no significant effect on storage as compared to control samples. The highest lightness index was find out in MY2 with values from 82.30 and lowest was in MY1 with 80.5 is detected at the 1st day of the storage condition. At the end of the storage period (21st day), decreased lightness (L*) was in MY1 along with control respectively. While in MY2 was more stable throughout the storage period as compared to other samples including control (Yu *et al.*, 2021). Also, fermentation time and temperature did not come into contact with the quality of MCT incorporated yogurt samples after refrigerated conditions (4° C during storage).

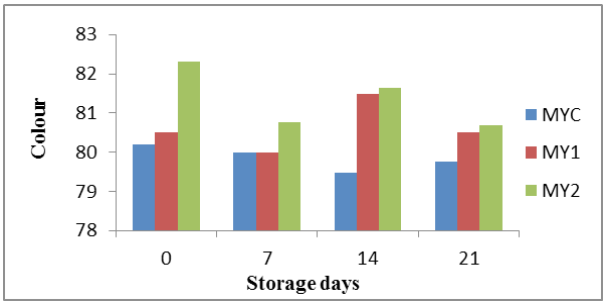

Fig. 1. Effect of colour index of yogurt drink fortified with MCT oil samples on storage period. *Note Results were tabulated as Mean±SD

pH , TSS and TA

Table 1 demonstrated that the pH of yoghurt held at 5 °C for 21 days serves as an essential indicator of the number of bacteria present. Over the course of storage, the pH values of matured yoghurt dramatically reduced. All samples of yoghurt drinks had an initial pH of 4.56. During the period of storage, pH drastically decreased for samples at 43° C specially in MYC with 3.30 ± 0.11 respectively. While in MCT added samples MY2 showed

Table 1. Difference in pH, TSS and TA of yogurt samples with and without MCT

Storage days	MYC	MY1	MY2
pH			
0	4.72±0.05	4.56±0.05	4.62±0.11
7	4.39±0.05	4.00±0.08	4.42±0.04
14	4.25±0.10	3.58±0.05	4.10±0.05
21	3.30±0.11	3.34±0.07	3.96±0.10
TSS			
0	16.50±0.11	16.89±0.11	16.23±0.10
7	16.75±0.05	16.79±0.11	16.15±0.11
14	16.68±0.11	16.59±0.10	15.49±0.05
21	14.0±0.05	14.15±0.15	15.15±0.11
TA			
0	0.93±0.10	0.92±0.08	0.93±0.08
7	1.04±0.05	0.88±0.03	0.82±0.06
14	1.08±0.11	1.09±0.05	1.06±0.03
21	1.11±0.11	1.11±0.12	1.10±0.10

decreased pH at 43° C with 3.96 ± 0.10 respectively. Yogurt's pH drops and acidity rises as a result of the ongoing lactic acidification process, which is brought on by the associative growth of *Streptococcus thermophiles* and *Lactobacillus bulgaricus* as they ferment lactose. As evidenced by earlier studies, this trend was extraordinary. Similarly, TSS was also reduced during the storage period due to the utilization of soluble solids for the growth of microorganisms. The maximum reduction was exhibited by MYC and MY1 with 14.0 ± 0.05 and 14.15 ± 0.15 at 43° C. TA is inversely proportional to pH which means as pH is reduced significantly the TA will increase for yogurt drink samples. The TA was substantially higher in MYC samples than in MCT samples, with values of 1.11±0.11 and1.10±0.10 respectively. Additionally, MY2 and MY1 samples maintained a limited amount of stability for up to 14 days before gradually increasing for up to 21 days within a predetermined level of 1.11% lactic acid.

Syneresis

Based on the serum separation throughout the course of storage days at 5 °C, the stability of yoghurt drinks is reported in Table 2. A low serum separation rate suggests that milk proteins in yoghurt drinks are stable in acidic environments. Prepared yogurt drink with MCT were significantly more stable than control samples ($P < 0.05$). Comparing the MY2 at 43 C to control samples stored under refrigerators, the MY2 showed the lowest serum separation over the storage period with 22.11%. Syneresis is an undesired condition that causes whey to build up on yogurt's surface. Due to water molecules, there is a reduction in syneresis in the yogurt samples incorporated with MCT (Krawczyk *et al.*, 2009). However, a slight increase in syneresis could be expected in case of storage beyond 14 days, because of the saturation of MCT with water molecules

Storage days	MYC	MY1	MY2
0	8.07±0.12	8.24±0.15	19.68±0.37
7	22.58±0.25	19.51±0.27	20.74±0.81
14	23.42±0.12	20.71±0.83	23.46±0.31
21	29.81±0.26	24.01±0.38	22.11±0.54

Microbiology analysis (TPC)

The variations in the TPC of samples of yoghurt drinks with MCT fortification are shown in Fig. 2. During the storage time, the bacterial count also began to rise, reaching log10 CFU/ml in each sample, particularly in the samples heated to 43° C. The viable count of bacteria was too high in MYC control sample at optimum temperature, MY1 and MY2 with 6 and 5.85 CFU/ml respectively.

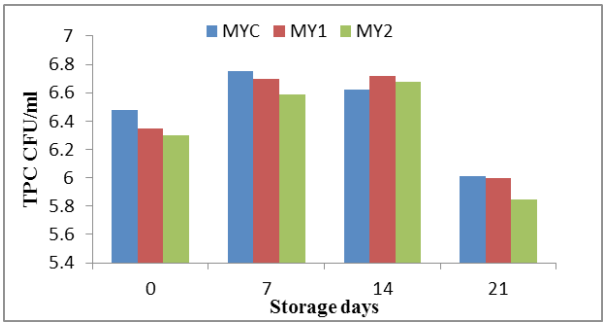

Fig. 2. Total plate counts (log10 CFU/ml) of yogurt drinks prepared with MCT (as a supplement) and control (without MCT) after 21 at 4 °C.

Acceptable index

For a product to be deemed acceptable from a sensory perspective, it must have an acceptability index of at least 70%. Figure 3 was displayed based on the results of this index. It was decided that the yoghurts with 1% MCT oil were preferable to the control formulation. The formulation with the highest index of acceptance was MY2 along with MY1 with 86.25%, 84.5%, respectively. Overall acceptability score was highest in MY2 with 7.9 points from the sensory panellist followed by MY1 (7.62).

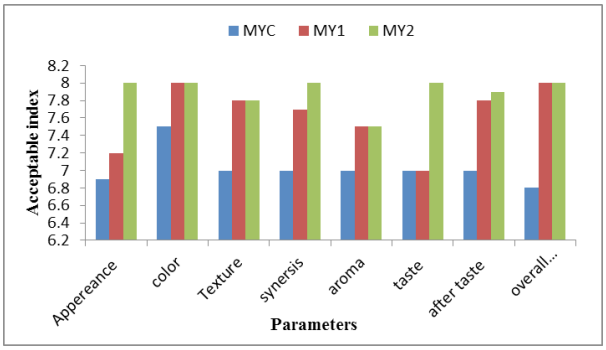

Fig. 3. Sensory scores of yogurt drink incorporated by MCT

CONCLUSION

The demand for ready to drink products is high in food markets currently. Yogurt drink is convenience and healthy probiotic rich product. The MCT oil incorporated yogurt drink was developed in this study. Incorporation of medium chain triglyceride

oil (MCT) to the yogurt drink was an effective approach for food industry which enhances the nutraceutical properties of yogurt drink. The MCT oil fortified functional yogurt drink showed a positive response with physico chemical, microbiological properties. The yogurt sample with concentration of 1 % of MCT treated at 43° C showed the best results compared to control (MYC) samples with good acceptable microbial load. The overall sensory attributes shown good acceptability index with treated sample compared to control sample during storage period.

ACKNOWLEDGMENT

Kusuma N Waded thanks the Council of Scientific and Industrial Research (CSIR), Government of India, for the SRF fellowship.

Conflict of Interest

The authors have no conflict of interest to declare.

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