RESEARCH ARTICLE

European Journal of Agriculture and Food Sciences
www.ejfood.org

Effect of Addition of Coffee Extract on Physicochemical and Sensory Properties of Yoghurt

Jonah Mbae, Richard Koskei, and Beatrice Mugendi

ABSTRACT

Yoghurt is among high value dairy products that are cultured using live organisms and termed as a probiotic carrier. Yoghurt was flavoured using coffee extract to allow diversification of dairy cultured products. In this research, the potential effect of coffee extract on the physicochemical and sensory properties of coffee flavored yoghurt was studied. A complete randomized design was used where four treatments were assigned to twelve experimental units. The treatments were prepared by addition of coffee extract to the yoghurt in the ratio of 0.0% (control), 0.1%, 0.2%, and 0.3%. The treatments were made in three replicates. The samples were analyzed for physicochemical properties and sensory evaluation. Physicochemical properties analyzed included pH, titratable acidity, viscosity and syneresis. Sensory evaluation was conducted by eighteen untrained panelists who were consumers of yoghurt. All were drawn from both students and the staff in the Institute of Food Bioresources Technology, using a nine-point hedonic scale. Data was analyzed by use of ANOVA, means separated by fisher's LSD at p<0.05 level of significance. From the findings, pH gave readings between 4.45±0.0 and 3.92±0.0. Results for titratable acidity was between 0.78±0.0 and 0.93±0.0. Viscosity ranged from 3241.7±62.9 to 2041.7±14.4, while results for Syneresis were between 8.93±0.5 and 25.33±0.6. Significant differences were recorded in all physicochemical properties evaluated in this research, while sensory scores ranged from 6.5 to 8.5 and significance difference was recorded in all sensory parameters used except in texture and aroma. Physicochemical properties of yoghurt were found to influence the quality and overall acceptability of yoghurt by the consumers.

Keywords: coffee extract, yoghurt, physicochemical properties, sensory.

Submitted: March 11, 2022
Published: January 17, 2023
ISSN: 2684-1827
DOI: 10.24018/ejfood.2023.5.1.478

J. Mbae*
Institute of Food Bioresources Technology, Dedan Kimathi University of Technology, Kenya
(e-mail: jonahmbae@gmail.com)
R. Koskei
Institute of Food Bioresources Technology, Dedan Kimathi University of Technology, Kenya
(e-mail: kipkorir.koskei@dkut.ac.ke)
B. Mugendi
Murang'a University of Technology, Kenya
(e-mail: bmugendi@mut.co.ke)

***Corresponding Author**

I. Introduction

A. Background Information

Yoghurt is a dairy product processed by fermenting milk using bacterial culture with or without sugar. The bacterial culture converts lactose into lactic acid and other derivatives [1]. In general fermented products are considered to have a better improved nutrition compared to their raw materials [1]. The breakdown of lactose into lactic acid, acetaldehyde and other derivatives improves the organoleptic characteristics of yoghurt. This fermentation process lowers the pH and raises the titratable acidity of the yoghurt thus making calcium more bioavailable and easily assimilated into the body [6]. This also increased the intake of the yoghurt by the lactose intolerant people as well as lengthening the shelf life of milk [7]. The physicochemical properties such as pH, titratable acidity, syneresis and viscosity influence the sensory characteristics of yoghurt [5], [6]. Syneresis is the separation of whey protein from the gel matrix of casein micelles interfering with the viscosity of the yogurt. This removal of serum from the casein matrix compromises the quality of yoghurt. Different types of yoghurts have been developed by improving and innovatively modifying the recipe by including artificial additives. This has brought many varieties of yoghurt from high to low fat, drinking and eating yoghurt [1]. In addition fruit based yoghurt and fruit flavoured yoghurt drinks with artificial additives(coloring and flavoring agents) have been developed to meet different consumer needs [5]. These artificial additives have been found to affect health negatively and therefore there is need to exclude them during yoghurt processing [9]. Most of the artificial courant used in dairy and other food products have been reported as potential carcinogen thus making these food product to compromise the health of the consumer [4]. However natural coffee extract has been used as an important flavour and colour ingredient and as an alternative to the artificial additives in yoghurt with additional benefits of improving the functional properties including total polyphenolic compounds which can boost the antioxidant activity of the product [10]. Coffee is a beverage rich in bioactive compounds such as polyphenols which are both present before roasting and after roasting [11]. According to [12] the total polyphenolic compounds in coffee contribute to the health of the consumer by possessing protective factors against human degenerative diseases [13], [14]. Enhancing yoghurt with coffee extract has been found to influence other factors such as physicochemical properties that determine the quality and sensory acceptability of yoghurt by the consumers. The aim of this research was to study the influence of coffee extract on the physicochemical and sensory properties of yoghurt.

II. Materials and Methods

A. Collection of Samples and Preparation

Raw milk was obtained from university farm (DeKUT), yoghurt culture (YF-L812, CHR HANSEN, Denmark) was bought from Promaco Limited. Sugar and skimmed milk powder was obtained from the supermarket in Nyeri town. Coffee extract was prepared from coffee research laboratory (DeKUT). Yoghurt was processed by pre-warming twelve liters of milk to 60ºC.Sugar and skimmed milk powder were mixed with 1 liter of milk and filtered with a muslin cloth and added to the larger batch of milk. The mixture was pasteurized at 90ºC for 30 minutes. The milk was cooled to 43ºC before the addition of starter culture. The bacterial culture which is a combination of two species, Streptococcus thermophilus and lactobacillus bulgaricus was added at the rate of 2% v/v. The milk was then incubated at 43ºC for six hours to achieve a pH of 4.6. Four treatments in replicates were prepared by adding coffee extract into the yoghurt in different ratios of control (0.0%), 0.1%, 0.2% and 0.3% coffee extract. The treatments were made in triplicates, packaged in plastic bottles, and stored under refrigeration at temperatures of 8ºC as it awaits analysis.

B. Experimental Design and Treatment

A Complete Randomized Design (CRD) was used to prepare the treatments of this research. Four treatments in triplicates were prepared by adding coffee extracts to the yoghurt as follows; 0.0% was the control, 0.1% coffee extract, 0.2% coffee extract and 0.3% coffee extract. This yielded a total of twelve samples packaged into small packages for ease of sampling and analysis. Sampling was done every week for three weeks and were frozen at -18ºC waiting for analysis.

C. Determination of Ph

The pH was determined by the method described by [6], where 10g of the sample was dissolved in 100 ml of distilled water. The mixture was allowed to equilibrate for 3 minutes at room temperature. The pH was then determined by inserting the electrode of the Hanna HI8915 Germany pH meter in the sample then taking the result displayed on the pH meter.

D. Determination of Total Titratable Acidity (TTA)

This was determined by the method described by [2]. Ten milliliters of sample were diluted with 10ml of distilled water and mixed thoroughly. One milliliter of phenolphthalein indicator was added into the mixture and was titrated against standard 0.1N sodium hydroxide solution until pink colour persisted for about 15 seconds for complete neutralization. The total titratable acidity was calculated using the formula below.

$$\mathrm{TTA}(\%) = \frac{\mathrm{Titer\ x0.1Nx90}}{\mathrm{Vol.\ samplex1000}}\mathrm{X100} \qquad (1)$$

E. Yoghurt Viscosity Determination

Yoghurt viscosity was measured using Brookfield viscometer model BM type. Analysis was done according to the methods described by [3] with little modifications. Three readings from every sample were taken and an average was recorded. The readings were taken at 10ºC, the temperature at which the yoghurt is consumed. The spindle speed was adjusted according to the thickness of yoghurt sample. In this case, the specification combination used spindle number two and speed six (revolutions/second). To calculate the final viscosity in centipoises, a factor of fifty (50) obtained from the conversion table was used to multiply the obtained figure.

F. Determination of Syneresis of Yoghurt

Samples Were Evaluated For Presence of syneresis during storage of yoghurt using centrifugation method by [13] with little modification. Twenty-five milliliters of the sample were centrifuged in duplicate at 3500 rpm for 10 min per sample and the whey that separated was weighed and determined as a percentage syneresis.

G. Sensory analysis

The samples for analysis were coded and presented to eighteen (18) untrained panelists who were drawn from the Institute of Food Bioresources Technology (IFBT) both students and staff who were familiar with yoghurt. The samples were analyzed based on the following attributes: appearance, aroma, texture, taste and overall acceptability of the sample using a 9 point Hedonic scale, where 9 indicates extremely like and 1 extremely dislike [4]. Fifty milliliters of all samples were placed strategically using 150ml cups with individual panelists tasting and rinsing their mouth with distilled water between the samples while recording results.

H. Data analysis

Data was analyzed using one way analysis of variance (ANOVA) means were compared using fisher's Least Significance Difference (LSD) at $P<0.05$. Analyzed data was presented in a table and a graph.

III. Results and Discussions

A. Ph of the Coffee Flavored Yoghurt

The pH values are shown in Table I. Analysis of pH in the samples was done for three weeks. The findings showed all treatments had significant difference ($p\leq 0.05$) in the level of pH. It was also noted that the pH in all treatments decreased as the concentration of the coffee extract increased. According [15] indicated that addition of coffee powder into the yoghurt was found to decrease the pH of the yoghurt. In weeks 1 and 2, treatment 0.0% recorded the highest pH values, while treatment 0.3% recorded the lowest. In week three treatment 0.2% recorded the highest pH and 0.0% recorded the lowest pH. This variation in the pH could be attributed to the increased production of lactic acid by the LAB during the three weeks of cold storage. This is in agreement with the report of [16] who indicated that the high incubation and storage temperature had an effect on pH of yoghurt due to LABs metabolic activity. It was noted that there was a decrease of pH alongside the storage period that was significantly different from week 1 to week 3 in treatment 0.0%, 0.2% and 0.3%. This is because of post acidification facilitated by the LABs in the yoghurt through breakdown of lactose to yield lactic acid acetaldehyde, esters and carbon dioxide thus lowering the pH [16], [17]. The pH values for all the samples in this study was less than 4.5 hence they met the FDA (Food Drug Administration) specifications for yoghurt of a maximum pH of 4.5 [6]. Low pH values in yoghurt makes calcium present in milk more bioavailable for absorption in the intestines through its conversion into its ionic form [6].

TABLE I: PHYSICOCHEMICAL PROPERTIES OF COFFEE FLAVORED YOGHURT TREATMENTS (%COFFEE EXTRACT)

Parameters	Week	Control	0.1	0.2	0.3
pH	1	4.45±0.0 ^{aA}	4.42±0.0 ^{bA}	4.39±0.0 ^{cA}	4.34±0.0 ^{dA}
	2	4.42±0.0 ^{aA}	4.39±0.0 ^{bA}	4.38±0.0 ^{bB}	4.32±0.0 ^{cA}
	3	4.15±0.0 ^{dB}	4.31±0.0 ^{bA}	4.36±0.0 ^{aC}	4.28±0.0 ^{cA}
Titratable Acidity (%)	1	0.78±0.0 ^{dA}	0.78±0.0 ^{cB}	0.79±0.0 ^{bA}	0.80±0.0 ^{aA}
	2	0.78±0.0 ^{bA}	0.80±0.0 ^{aA}	0.80±0.0 ^{aA}	0.80±0.0 ^{aA}
	3	0.79±0.0 ^{bA}	0.80±0.0 ^{abA}	0.80±0.0 ^{aA}	0.81±0.0 ^{aA}
Syneresis (%)	1	11.20±0.4 ^{aC}	8.80±0.8 ^{bC}	8.93±0.5 ^{bB}	9.07±0.6 ^{bB}
	2	14.40±0.8 ^{aB}	10.53±0.6 ^{bB}	9.07±0.8 ^{cB}	9.47±0.6 ^{bcB}
	3	18.67±1.6 ^{aA}	17.47±0.5 ^{aA}	13.87±0.2 ^{bA}	12.0±1.4 ^{bA}
Viscosity (cP)	1	3241.7±62.9 ^{aB}	3125±66.1 ^{bB}	2971.7±45.1 ^{cB}	3008.3±38.2 ^{cB}
	2	3241.7±14.4 ^{dB}	3616.7±57.7 ^{cA}	3716.7±76.4 ^{bA}	3833.3±57.7 ^{aA}
	3	3591.7±14.4 ^{dA}	3658.3±14.4 ^{cA}	3716.7±76.4 ^{bA}	3850±50.0 ^{aA}

The data are mean values±standard deviation (SD) of three replicates. Values marked with different superscript letters (a–d) within a row and (A–B) within a column are significantly different ($p<0.05$).

B. Total Titratable Acidity (TTA) of Yoghurt

Total Titratable Acidity (TTA) of coffee extract added yoghurt are shown on Table I. All the treatments showed significant differences at $p<0.05$ for titratable acidity in all the samples studied for three weeks. The samples with coffee extracts showed a higher titratable acidity than the control samples. This could be attributed to the effects of the coffee extract used and the lactic acid produced by LABs through the process of fermentation. According to [18] post acidification of coffee flavoured yoghurt occurred after 21 days of storage. Treatment 0.0% did not have the coffee extract and its titratable acidity depended on acidity formed through the fermentation process of the bacteria breaking down lactose in the milk hence showed low value than the other treatments that contained coffee extract. Among the treatments with coffee extract, treatment 0.3% showed the highest significant TTA which could be attributed to the influence of the highest concentration of coffee extract. It has also been reported that the bacteria utilized the polyphenolic compounds as nutrients boosting their activity in metabolizing lactose to produce more lactic acid [17]. This confirms that coffee extract and cold storage do not stop the activity of lactic acid bacteria but slows the growth rate. This is also supported by the report of [18] who indicated that post acidification occurs during cold storage of coffee flavoured yoghurt. However all the samples met the minimum requirement for Total Titratable Acidity TTA upon storage which was within the recommended value of above 0.6% [19]. The titratable acidity in yoghurt is key to determine the quality of the yoghurt in terms of sensory characteristics and consumer acceptability of the product.

C. Syneresis in the Yoghurt

Syneresis is the tendency of whey to separate from the rest of the components in yoghurt. This phenomenon is usually reduced by the use of stabilizers and thickeners to hold these components together in an emulsion. In this research skimmed milk powder was used as a stabilizer. Syneresis values were found to be between 8.80±0.8 and 18.67±1.6 as shown on Table I. These results were found to be slightly higher than those reported by [17] who recorded lower values of less than 8% when coffee was added into the yoghurt. ($p\leq0.05$) in week one, the control recorded the highest viscosity which was significantly different from the other treatments while in week 2 significance difference was recorded between treatments 0.0%, 0.1% and 0.2% with treatment 0.0% giving the highest viscosity. In week 3 the control (0.0%) recorded the highest syneresis which was significantly different from treatment 0.3%. This could be associated with formation of polyphenolic-protein linkages in the samples with coffee extracts tending to reduce syneresis. Coffee extract is reported to contain polyphenolic compounds that facilitates formation of phenol-protein linkage therefore trapping the whey in the matrix hence reducing syneresis [17] this is evidenced by a decrease in syneresis observed as the amount of coffee extract was increased along the treatments. It was also noted that syneresis increased significantly as the storage period was increased in all treatments and this could be attributed to the breaking of protein-phenol linkages due to the increasing production of lactic acid by LABs due to post acidification of yoghurt during storage [18]. These findings indicate that coffee extract could be used in stabilizing yoghurt thus reducing syneresis during cold storage of the product.

D. Viscosity of Yoghurt

The viscosity of coffee flavored, and non-coffee flavored yoghurt was evaluated, and the result given in Table I. Viscosity ranged from 2041.7±14.4 Cp to 3850±50.0 Cp. The viscosity levels were slightly higher than the range reported by [20] who gave a range of between 2510.25±39.84 and 2747.75±28.12 after comparing viscosity of thermosonicated yoghurt and convectional heated yoghurt. In week one of the studies 0.0% showed the highest viscosity that was significantly different from the other three treatments. This could be attributed to natural gelling of yoghurt during production in comparison to the other three treatments that contained the extract that could have interfered with the natural gelling before the formation of the protein phenol linkages during cold storage [17]. Significance difference at ($p \leq 0.05$) was also recorded in treatments 0.3% giving the highest level of viscosity than the other treatments in week 2 and 3 of study. This could be related to the formation of phenol-protein interaction due to the addition of coffee extract at varying concentrations causing the increase in viscosity as the coffee extract was increased [21]. The higher the coffee extract the higher the phenolic compounds available to form phenol-protein linkages hence increasing the viscosity of the yoghurt [20]. It was notable that viscosity increased significantly as the storage period was increased in all the treatments with week 1 recording the lowest viscosity which was significantly different from week 2 and 3 in all the treatments. The increase could be attributed to the increased interaction of protein-phenol linkage complexes as the storage time was increased. This interaction helps to promote stability of rheological characteristics of yoghurt [22].

E. Sensory Analysis of Yoghurt

Sensory analysis gives a final judgement on the acceptability of a food product. The attributes are entirely organoleptic testing that includes the five senses, the smell, touch, hearing, taste, and the sight. In this research acceptability testing was done using a nine-point hedonic scale method where various attributes including, appearance, aroma, texture, colour, taste and overall acceptability were assessed, and the results are shown in Fig. 1. The scores for texture indicated that there was no significant difference between the treatments. There was a significant difference in taste between treatments 0.2% and the control. The control scored the lowest on taste due to the absence of coffee extract hence addition of coffee extracts contributed to better taste of coffee yoghurt.

On colour there was a significant difference between the control and the other treatments. Treatment 0.0% showed a significantly lower score for colour due to the lack of coffee extract in the samples hence it was least preferred in terms of colour [21] compared to the other treatments that contained coffee extract due to the presence of melanoidins that develop during coffee roasting [22].

In terms of appearance, significant difference was recorded between control and the other treatments. The control recorded a lower score of 6.56 hence was least preferred among all the treatments. This could be linked to the absence of coffee extract in the samples which could have influenced the colour and general appearance during evaluation and scoring [15]. According to [23] indicated that formation of melanoidins during coffee roasting influences the colour of the coffee brew. This also influenced the appearance of the coffee flavoured yoghurt. The overall acceptability of the products was significantly different between the control and treatment 0.1% and 0.3%. Treatment 0.1% scored the highest with 8.39 which was significantly different from the control (0.0%) and 0.3%. This could be attributed to the moderate coffee extract that led to it preference in comparison to the control that had no coffee extract. Treatment 0.3% also gave a low score because it had too much coffee because it contained the highest concentration of the coffee extract and might have masked other attributes that contribute to overall judgement of the product like acidity (Fig. 1). This is in line with a research by [18] who reported that when coffee extract is increased panelists preference also increased but in this research preference was for samples with 0.1% coffee extract and then decreased down as the concentration of coffee extract increased. Overall acceptability of the samples indicated that the most preferred treatment was treatment 0.1% which was significantly different from 0.3% and the control (0.0%) and this could be linked to a more distinct flavour coupled with taste and aroma of coffee extract. This is in line with the report of [24] who found that chemical flavour components formed during roasting of coffee beans influences acceptability of coffee in terms of aroma flavour and colour and thus the acceptability of the coffee flavoured yoghurt.

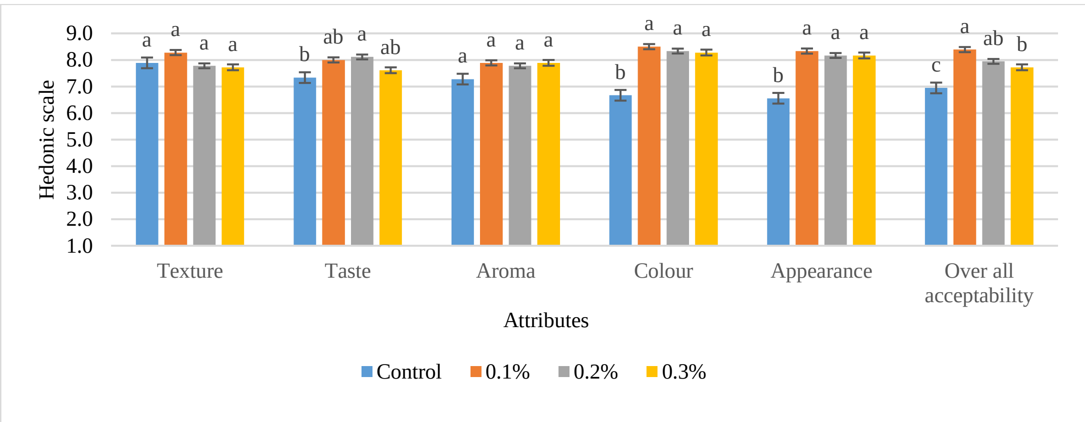

Fig. 1. Sensory attributes of yoghurt samples flavoured with varying concentrations of coffee extract.
The values mean±standard deviation (SD) of three replicates. Values within a bar marked with different letters are significantly different ($p<0.05$).
Hedonic scale 1-extremely dislike, 5-Neitherlike or dislike, 9-extremely like.

IV. Conclusion

Coffee extract influenced the physicochemical properties of yoghurt, in terms of titratable acidity, pH viscosity and syneresis of coffee flavoured yoghurt. Coffee extract increased the level of Total Titratable Acidity (TTA), while the pH was decreased. On the other hand, coffee extract also had positive influence on viscosity and syneresis by promoting phenolic-protein bond thus increasing the viscosity of yoghurt, minimizing syneresis and stabilizing the coffee flavoured yoghurt.

The coffee extract also improved the sensory characteristics of yoghurt in terms of taste, colour and aroma at moderate concentrations of 0.1 and 0.2%.

Finally, I recommend further research to ascertain the stability of coffee extract volatiles during storage of the coffee flavoured yoghurt. Additionally, I encourage consumption of coffee flavoured yoghurt for its health benefits and lastly commercial use of 0.1% or 0.2% coffee extract concentration for coffee flavored yoghurt.

References

[1] Azwar A, Hisbullah H, Irgi A, Julyadi W, Adisalamun A, Mukhlishien M, *et al*. Quality analysis of yoghurt from goat's milk using starter lactic acid bacteria. *J Serambi Eng.* 2021;7(1):2577–86.
[2] Weerathilake WAD V, Rasika DMD, Ruwanmali JKU, Munasinghe MADD. The evolution, processing, varieties and health benefits of yogurt. Int J Sci Res Publ [Internet]. 2014;4(1):2250–3153. Available from: www.ijsrp.org.
[3] Matela KS, Pillai MK, Thamae T. Evaluation of pH, titratable acidity, syneresis and sensory profiles of some yoghurt samples from the kingdom of Lesotho. *Food Res.* 2019*;*3(6):693–7.
[4] Farhana N, Ari AB, Ezuan M, Rios-solis L. In fl uence of probiotics , prebiotics , synbiotics and bioactive phytochemicals on the formulation of functional yogurt. *Journal of Functional Foods*. 2018 Sep 1; 48:387–99.
[5] Oladimeji TE, Oyinlola R, Odigure JO. Effects of incubation temperature on the physical and chemical properties of yoghurt. In 3rd *International Conference on African Development Issues*, 100Ã¢ â¬ â 2016 (Vol. 102).
[6] Ibrahim AN, Igwe CE, Asogwa IS, Agbaka JI, Ajibo QC. Influence of Ocimum gratissimum (Scent Leaf) on the Organoleptic Acceptability and Shelf Stability of Yoghurt. *Asian Food Sci J.* 2020;16(1):28–44.
[7] Oplatowska-Stachowiak M, Elliott CT. Food colors: Existing and emerging food safety concerns. *Crit Rev Food Sci Nutr* [Internet]. 2017;57(3):524–48. Available from:http://dx.doi.org/10.1080/10408398.2014.889652.
[8] Chakraborty C, Bandyopadhyay K, Ganguly S. Evaluation of rheological, physicochemical and sensory properties of low calorie coffee yogurt. *Pharma Innov J.* 2017;6(7):106–9.
[9] Bobková A, Hudáček M, Jakabová S, Belej Ľ, Capcarová M, Čurlej J, et al. The effect of roasting on the total polyphenols and antioxidant activity of coffee. *J Environ Sci Heal-Part B Pestic Food Contam Agric Wastes* [Internet]. 2020;55(5):495–500. Available from: https://doi.org/10.1080/03601234.2020.1724660.
[10] Nieber K. The impact of coffee on health author pharmacokinetics and mode of action bioactive components in coffee. *Planta Med.* 2017;83(1):1256–63.
[11] Pourshahidi LK, Navarini L, Petracco M, Strain JJ. A comprehensive overview of the risks and benefits of coffee consumption. *Compr Rev Food Sci Food Saf.* 2016;15(4):671–84.
[12] Król K, Gantner M, Tatarak A, Hallmann E. The content of polyphenols in coffee beans as roasting, origin and storage effect. *Eur Food Res Technol* [Internet]. 2020;246(1):33–9. Available from: https://doi.org/10.1007/s00217-019-03388-9.
[13] AOAC, George WL. Official methods of analysis of AOAC International. Rockville, MD: *AOAC International,* ISBN: 978-0-935584-87-5. 2016;20th Edition(Rockville, MD: AOAC International, ISBN: 978-0-935584-87-5.).
[14] Abdelmoneim AH, Sherif AM, Sameh KA. Rheological properties of yoghurt manufactured by using different types of hydrocolloids. *Austin J Nutr Food Sci.* 2016;4(2):1–6.
[15] Joon R, Mishra SK, Brar GS, Singh PK, Panwar H. Instrumental texture and syneresis analysis of yoghurt prepared from goat and cow milk. *Pharma Innov J* [Internet]. 2017;6(7):971–4. Available from: www.thepharmajournal.com.
[16] Igbabul B, Shember J, Amove J. Physicochemical , microbiological and sensory evaluation of yoghurt sold in Makurdi metropolis. *African J Food Sci Technol.* 2014;5(6):129–35.
[17] Vimercati WC, Araújo C da S, Macedo LL, Fonseca HC, Guimarães JS, Abreu LR de, *et al*. Physicochemical, rheological, microbiological and sensory properties of newly developed coffee flavored kefir. *Lwt.* 2020;123.
[18] Dönmez Ö, Mogol BA, Gökmen V. Syneresis and rheological behaviors of set yogurt containing green tea and green coffee powders. *J Dairy Sci* [Internet]. 2017;100(2):901–7. Available from: http://dx.doi.org/10.3168/jds.2016-11262.
[19] M.H.Marhamatizadeh, Ehsandoost E, Gholami P. The effect of coffee extract on the growth and viability of lactobacillus acidophillus and bifidobacterium bifidum in probiotic milk and yoghurt. *Food Biosci Technol.* 2014;4(1):37–48.
[20] *Kenya standard fermented (cultured) milks-specification*.World HealthOrganization,Food and Agriculture Organization of the united nations,Rome,2011,CXS,243-2003.Adopted in 2003. Revised in 2008, 2010, 2018. Kenya Bureau of Standards, 2018.
[21] Krisnaningsih AJUT, Radiati Leka. The effect of incubation time to the physicochemical and microbial properties of yoghurt with local taro (colocasia esculenta (l .) Schott) starch as stabilizer. *Current Research in Nutrition and Food Science J.* 2019;7(2):4–11.
[22] Connell JEO, Fox PF. Significance and applications of phenolic compounds in the production and quality of milk and dairy products : a review. *Elsevier.* 2001;11:103–20.
[23] Shalaby H, Elhassaneen Y. Functional and healthy properties of yoghurt adding to green tea and coffee extracts on reducing obese and its complications in rats. *Research square*. 2021; Available from: https://doi.org/10.21203/rs.3.rs-293107/v1.
[24] Riener J, Noci F, Cronin DA, Morgan DJ, Lyng JG. A comparison of selected quality characteristics of yoghurts prepared from thermosonicated and conventionally heated milks. *Food Chem* [Internet]. 2010;119(3):1108–13. Available from: http://dx.doi.org/10.1016/j.foodchem.2009.08.025.
[25] Dybkowska E, Sadowska A, Rakowska R, Dębowska M, Świderski F, Świąder K. Assessing polyphenols content and antioxidant activity in coffee beans according to origin and the degree of roasting. *Rocz Panstw Zakl Hig.* 2017;68(4):347–53.
[26] Wei F, Tanokura M. Organic Compounds in Green Coffee Beans [Internet]. Coffee in Health and Disease Prevention. *Elsevier Inc.;* 2015; 1: 149–162 Available from: http://dx.doi.org/10.1016/B978-0-12-409517-5.00017-6.

Jonah Mbae is Researcher at Dedan Kimathi University of Technology-Kenya
M.Sc. Food Science and Technology, Dedan Kimathi University of Technology, Kenya.
Undergraduate B.Sc. Food Science and Technology, Technical University of Kenya.
Area of specialization-Food microbiology, Food safety, Food chemistry and dairy Technology.