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Review: Technology Development to Incorporate Functional Oil Sources in Yoghurt to Improve Functional Properties

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Key Words

Functional oils, yoghurt, functional properties, spices, fruits

Abstract

This review mainly focuses on Functional oils (FO) including essential oils (EO) associated with yoghurt production which induces functional properties. Dairy industries are using functional ingredients such as ginger and garlic, Aloevera, fruit pulps, bee honey, plant extracts and spices (such as clove, cinnamon, pepper, and mustard oils). The oil available in the food ingredients can be used for this purpose. Yoghurt is produced by lactic acid fermentation by specific microorganisms and the keeping quality of perishable dairy products is improved by applying plant FOs. The chemical composition of spices such as cinnamon oil contains cinnamaldehyde (68.11%,), and eugenol (4.57%). Also, clove oil is having Eugenol (80.00%), and beta-caryophyllene (14.70%). Garlic constitutes valuable natural antioxidants as the bioactive compounds such as allyl methyl trisulfide (13.20%), allyl (E) - 1 - propenyl disulfide (12.50%). Also, ginger is having a-Zingiberene (30.06%), and β-sesquiphellandrene (10.71%), therefore yoghurt can be enhanced by fortification with those FOs. The bioactive ingredients are available in these essential oils are having antimicrobial properties, anti-cancer, anti-ulcer, antioxidant and anti-fungal abilities. It was identified that there were some significant changes observed during storage with the total solids (TS) of yoghurt using several types of FO. Thus, the pH decreased gradually; simultaneously the titratable acidity was also increased gradually during storage. Also, significant differences in the flavor were observed. Sensory evaluation analysis revealed that the total score was decreased slightly during storage.

1. Introduction

Dairy products are famous for nutrition and it is important for nutrition in many parts of the world due to its complete nutrition availability. Many people try to add value to yoghurt and it is becoming a popular fermented milk product in the world. Therefore, the milk and dairy products are playing a popular role all over the world in the form of functionality and some time the nutrition content. It has a significant enhancement of immunity of people because it was added with some of the specific raw ingredients available in the nature with functional properties.

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Ingredients such as pure honey, fruits, spice extracts and some other functional ingredients are incorporated into the yoghurt to add value, treating some functional ingredient deficiencies and increase the acceptability of the people. Some of the functional oils extracted from some of the spices and fruits are incorporate into dairy products in a minute amount to increase the quality of yoghurt (Wedad A et al., 2007). When the market availability was shifted towards addition of honey, trickles, fruits and spice oils; it helps to increase the value of particular yoghurt, acceptability and profitability. It is reported that yoghurt can be kept inside the refrigerators for a 1-1.5 months. It is the growing challenge of dairy industry(Lewis, 2003).

The pasteurized products are not fully sterile and the percentage of sterility is found to be very less than the sterilized and UHT treated product(Smit, 2003). The milk products added with functional ingredients has significant digestibility, taste, texture and acceptability and it gives a massive market demand all over the world (Akin & Konar, 1999). Fermented milk products are included in higher percentage in the daily food intake due its great food value and the palatability. yoghurts are fermented with lactic acid fermenting bacteria, consumption of these products kept the people much healthier and physically stronger(Sfakianakis & Tzia, 2014).

The development of innovative technologies in dairy processing and the high growing demand in the food chain, fermented product specially yoghurt added with different ingredients are continuously modified by the researchers and subsequently evaluated by research and development scientists and food experts to meet the consumer demand and their satisfaction. Food scientists and the nutritionists working of functional properties are considering the bioactivities to include naturally available cost effective and inexpensive sources(Anal, 2019) of functional ingredients and nutrients to make it a nearly complete diet for human consumption. The development of healthy foods, there is a growing demand and increasing trend to fortify and enrich milk and dairy products with fruits (Saleh et al., 2018). Similarly, fruits and its derivatives can be incorporated as the most popular functional, flavoring and value-added ingredient for fermented products specially yoghurt products(Benchikh et al., 2021).

Fruits are consumed as deserts and sometime part of the human food intake and it is considered as a food supplement too(Crozier et al., 2006). It is recommended as an important and essential to have a healthy nutrition which is necessary for health because they have much amount of water, sugars, vitamins, minerals and phytochemicals(Gangwar et al., 2016),(Crozier et al., 2006),(Cinbas & Yazici, 2008). However, the processing of flavored yoghurts in the dairy industries, natural fruits are most commonly used. Fruits are added into the yoghurt formulae as a form of single/mix. Due to that the acidotic condition available in the fruits frozen yoghurt is affected(Amal et al., 2016),(Pratap et al., 2016).

Some fruits such as strawberry, blueberry, apple, cherry, grapes, date and other fruit derivatives or homogenates are also added to the yoghurt to increase its functional properties(Küçüköner & Tarakçı, 2003). Sometimes heavy metals also should be screened due to the significant water consumption by plants(Samadiy & Deng, 2021, . Ju Xiao et al.,2022, Yingchun Xie et al., 2022). The bioactive components are available in as an essential oil, functional oils and it is having antimicrobial property (Gutierrez et al., 2008), It is due to their internal chemical composition, phenolic components and lipophilicity (Dorman & Deans, 2000).

Plant or fruit essential oils are also applied as decontaminating agents in dair products. It is also considered by most of the food experts (Chávez-González et al., 2016). Desirable compounds such as chemicals and biological properties available inside, they apply this technology in the food industries and some pharmaceutical industries (Wen et. al 2021). Probiotics, some micronutrients, and other bioactive substances shows significant antidepressant properties (Wu et al., 2022).

The bioactive and functional properties are found in oils special essential oil fractions and most of them have antimicrobial property (Ozogul et al., 2020). This review was focused on functional properties of oils and to discuss the possibility of developing technology to incorporate essential oil sources in yoghurt.

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2. Objectives

- To understand the functional properties of sources of essential oil in yoghurt.
- To suggest ways to improve value-added yoghurt production.

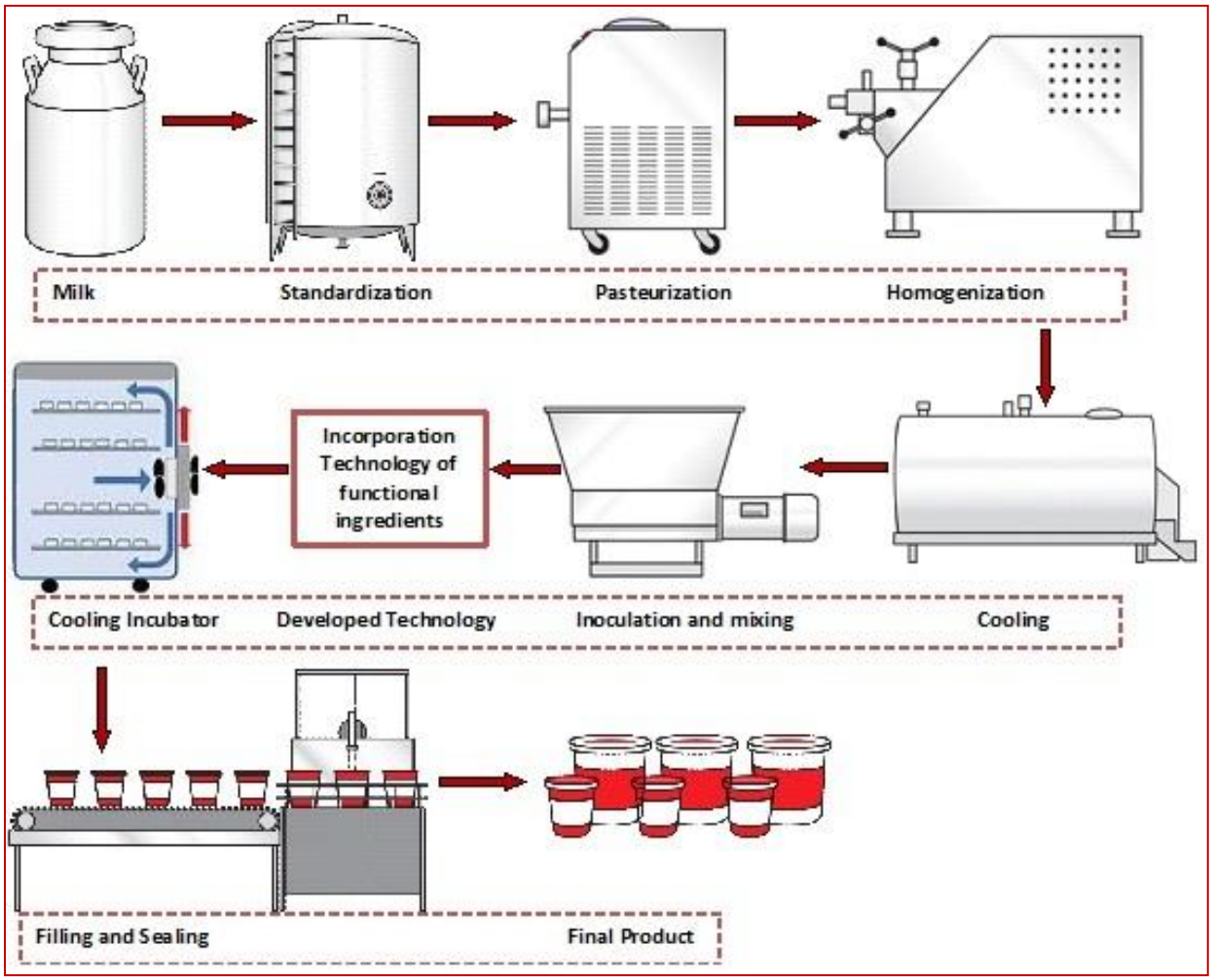

Figure.1: Process Diagram for Incorporation of Fruits in yoghurt

Incorporation of honey

Bioactivities and functionality of yoghurts are improved with addition of honey (Alvarez-Suarez et al., 2010; Sarkar & Chandra, 2019). It can be used with different yoghurt cultures and its functional properties will extend health benefits of human. Most dairy companies suggested that 10 % of honey can be used as a sweetening agent instead of sugar because it is also having a sweet flavor along with functionality.

Honey is having the monosaccharide, fructose and glucose and it is responsible for the sweet flavor. It will reduce the amount of sugar added to yoghurt to minimize the cost of production. It is having some effects on bacteria(Taormina et al., 2001), harmful bacteria such as *E.coli*, *Listeria monocytogenes*, *Sammonella typhi*, *Staphylococcus aureus and Bacillus cereus* (Israili, 2014). Also it is having medicinal and antibacterial effects(Kumar et al., 2010).

Honey incorporated dairy product has a high functional and nutritional value and is suggested by nutritionist to use as primary source of nutrition for children. It contains proteins, mainly enzymes, some of the amino acids (Alvarez-Suarez et al., 2010) and also bioactive functional oils(Tyowua et al., 2022). It

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has been found that honey is having different properties with the different locations.

Incorporation of Ginger (*Zingiber officinale*)

Ginger extract in yoghurt are now studied by the food scientists because it has significant effect on flavor, color, antioxidant ability and textural properties(Larasati et al., 2018). The ginger is utilized in culinary condiments and medicine(Sachan et al., 2018). Also, it has phytochemicals and disagreeable and fragrant scent and also good taste. The ginger extract has polyphenol compounds which express high antioxidant ability, preventive and therapeutic properties. Ginger is having approximately 1- 3% volatile oils & several pungent compounds (Chrubasik et al., 2005).

Ginger juice, ginger powder, ginger shreds, ginger fresh and extract, sugar syrup treated ginger shreds, honey treated ginger, are available in the market to use in food (Amadou et al., 2018). It is used in the treatment to cure gastrointestinal ailments (Dissanayake et al., 2020), anti-carcinogenic (Rehman & Fatima, 2018), prevent colon cancer(Shukla & Singh, 2007), antimicrobial properties(Shahrajabian et al., 2019), promoting heart muscle contractions(Fakhri et al., 2021) and blood circulation (Daharia et al., 2022) throughout the body. It also aids in lowering blood pressure and reducing the cardiac workload.

Table 1. Proximate composition of Ginger

Composition	**Quantity (%)** **(Agu et al., 2016)**	**Quantity (%)** **(Odebunmi et al., 2009)**
Moisture content	70.10	76.86
Crude protein	13.13	23.14
Crude fat	08.20	05.62
Crude fiber	09.00	08.75
Ash	02.35	02.54

Ginger incorporated yoghurts are now available in the market as value-added, functional dairy product and it is also same time boosting the sale of important spices in the industry. Ginger powder incorporated yoghurt production(Felfoul et al., 2017) was studied and it suggested that ginger powder could be added to cow milk at a concentration ranging from 0.50%-2.50% (w/v). It is accelerating the pH reduction rate, decreasing the syneresis rate, total solid contents, viscosity, and improved the yoghurt texture properties (Felfoul et al., 2017).

Incorporation of Garlic extracts, and oils

Garlic or its derivative oil is incorporated into the yoghurt to increase its functionality(Nazari et al., 2019). It is utilized as a medicine and food(*Allium sativum*)(Katzer, 2005), having nice smell to the products during cooking (Edris & Fadel, 2002). It is having insecticidal(Prowse et al., 2006), antimicrobial(Goncagul & Ayaz, 2010; Strika et al., 2017), antiprotozoal(McClure & Nolan, 1995) and anticancer properties (Sajid et al., 2014),(Edris & Fadel, 2002),(Gündoğdu et al., 2009). Garlic improves the immunity(Rivlin, 2001).

The study on garlic nutritional composition found that garlic has approximately 28% of carbohydrates, and 2.3% organosulfur(Felfoul et al., 2017) shown in table 02. Garlic is having functional properties and bioactivities due to its volatile oil such as Diallyl trisulfide, Diallyl disulfide and Diallyl sulfide (Dziri et al., 2014) which is volatile and also it is thermally unstable and lost the functional properties with the application of high temperature or thermal processing(Zhao et al., 2021). Garlic essential oil incorporated yoghurt is also a new value-added product used as a condiment or functional ingredient all over the world because of

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its pungent flavor(Edris & Fadel, 2002). Garlic is a atment for vascular calcification who is having high level of blood cholesterol(Hom et al., 2015). It contains "Allicin" which contributes antibacterial and antifungal chemical (Harris et al., 2001). Also, it gives distinct flavor and fragrance(Altuntas & Korukluoglu, 2019). Garlic is used in food as a juice, powder, fresh and extract, essential oil, and paste(Rounds et al., 2012).

Table 2. Proximate composition of Garlic

Parameter	**Quantity (%)** (Sajid et al., 2014)	**Quantity (%)** (Devi & Brar, 2018)	**Quantity (%)** (Odebunmi et al., 2009)
Moisture(Fresh weight)	64.58 ± 2.06	53.37 ± 0.54	66.57 ± 1.58
Crude protein	07.87 ± 0.32	04.85 ± 0.07	07.87 ± 0.76
Crude fiber	02.30 ± 0.08	02.07 ± 0.79	00.73 ± 0.19
Ash	02.46 ± 0.09	01.66 ± 0.01	01.33 ± 0.04
Crude fat	00.52 ± 0.01	00.66 ± 0.05	00.52 ± 0.09

Incorporation of Aloevera in yoghurt

Dairy products incorporating Aloe vera showed possitive result on functionality(Panesar & Shinde, 2012) and it has more acceptability(Al-Taif et al., 2022). The powder and juice of Aloe vera were used in dairy products specially for the preparation of yoghurt(Azari-Anpar et al., 2017). Aloe vera juice added yoghurt showed that it has better quality retention(Yadav et al., 2018), improve the immune system (Rajeswari et al., 2012) and improve blood circulation(Jadhav et al., 2020). Also, it has bioactive ingredients with antioxidant, aphrodisiac, antimicrobial, anti-inflammatory, antifungal, antiseptic, anti-helminthic, cure sunburns, cosmetic values for skin cancer removal, health care, minor cuts, and burns (Mikołajczak, 2018). The Aloevera gel contains 98% water(Bozzi et al., 2007), also antioxidant such as vitamins A, E and C (Lawless, 2000).

Table 3. Proximate Composition of Aloevera

Composition	**Quantity** (Ikram et al., 2021)
Moisture content	95.5 ± 0.04 **%**
Total solids	1.79 ± 0.01 **%**
Total soluble solids (Brix)	1.78 ± 0.02
pH	4.30 ± 0.09

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Acidity	0.27 ± 0.06
Protein	5.40 ± 0.4 **%**
Ash	22.1 ± 0.02 **%**

Aloevera mixed with yoghurts is consumed by most of the diabetes patients(Mootoosamy & Mahomoodally, 2014), reduce the glucose levels in diabetic patients and lower cholesterol in hyperlipidaemic patients(Christaki & Florou-Paneri, 2010), Antiulcer activity (Gopinathan & Rameela, 2014), the Anti-tumor(Saini et al., 2010) effect also very important in human.

Aloevera is having antibacterial properties by inhibiting the growth of some microorganisms especially food poisoning or diseases causing agents in animals and human(Christaki & Florou-Paneri, 2010). Aloevera has arachidonic acid, uric acid, γ-linolenic acid, salicylic acid(Ahlawat & Khatkar, 2011).

Incorporation of fruits in yoghurt

The World Health Organization (Organization, 2005) stated that the consuming vegetables and fruits should be included 5 times or servings or at least 400 g per day is recommended for humans. Yoghurt production can be done by incorporating some fruits to improve the nutritional values, functionality and the sensory properties(Küçüköner & Tarakçı, 2003). Yoghurts added with fruits as a functional ingredients are more delicious, giving refreshing flavors of fruit and the beneficial effect. These yoghurts are having more pleasing flavor and taste(Mahmood et al., 2008). The introduction of fruits added yoghurts are contributing to the consumption of yoghurt for human with different age groups significantly. Yoghurt formula is having single or mix form of fruits. The most common fruits are strawberry, spiced apple, orange, cherry, lemons, purple plum, pineapple, and Aloevera(Hui, 1993). It improves the nutritional value and varieties of yoghurts and this is in the form of probiotic fruit yoghurts. The probiotic bacteria and their survival in yoghurts was produced and studied by lot of scientists and investigated during the storage period(Kailasapathy et al., 2008).

Incorporation of Soursop

Plain yoghurt and also 0 - 15% of soursop juice or chops added yoghurt were prepared and investigated(Lutchmedial et al., 2004) and revealed that most panelists considered purchase of 10% to 15% of soursop added yoghurts due to its high medicinal value. The results of the related research found that soursop could be used as a source to incorporate yoghurt(Senadeera et al., 2018) and recommended as a medicine for human (Dias & Jayasooriya, 2017), contains many healthy nutrients such as amino acids, carbohydrates, fiber and vitamins which effectively reduce the risk of disease in human(Adedeji et al., 2014).

Incorporation of Cherry

Recent development of innovative technologies aimed on the functionality bioactive phenolic compounds found in cherries such as antioxidants property(Yook et al., 2010) and polyphenols are having many bioactivities such as anti-inflammation and anticancer factors are available (Ferretti et al., 2010). Cherry is a fruit which is having more attractive color and enhanced flavor and there are various research involved in incorporating cherry paste in yoghurt to improve flavor and functional properties (Celik et al., 2006). Yoghurt with 10 kg/100 L fruit paste was recommended by the researchers.

Incorporation of strawberry

Strawberry is rich in polyphenols specially anthocyanins and its antioxidant activity(Tsao & Li, 2016) in many forms of strawberry products such as processed forms of strawberry are significantly lower than raw strawberry particularly antioxidant activities by anthocyanins. Strawberry are enriched yoghurts are available in the markets (Oliveira et al., 2015).

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Incorporation of Grapes juice

The yoghurt incorporated with grapes had higher levels of antiradical activity, lower levels of radical scavenging activity, low pH, and low acidity, higher viscosity during storage(Oliveira et al., 2015). Quality of the yoghurts incorporated with grapes juice was improved and having significant taste(Hossain et al., 2012). Grapes juice has high mineral content dark yellow in color formed via nonenzymatic browning. The protein content of the grapes juice is around 0.63% and 83% of sugar of the total solids. The particular sugar availability gave best shelf life and used as a treatment for protein energy metabolism disorders patients. Also higher Fe content is around 5-10mg/ 100g in grapes makes useful for anaemia patients (Öztürk & Öner, 1999).

Grapes added yoghurt influenced on quality and fermentation process (Öztürk & Öner, 1999) and the, protein content, titratable acidity, viscosity, whey syneresis, pH, starter bacteria, yeast counts and mould were studied by some researchers suggested that 10% grape juice provided desired sweetness in yoghurt.

Addition of Apple and Mango in yoghurt

The incorporation of apple and mango in the form of juice or pulp to flavor the stirred yoghurt and it will act as potential prebiotic. Also, it increases nutritional quality, and sensory attributes, microbiological, rheological and physicochemical properties. it was identified that 10% of apple incorporated yoghurt expressed the best score compared to other fruit added yoghurt and plain yoghurt(Mansour et al., 2012),(Saleh et al., 2018). Addition of mango pulps and apple juice increased the acceptability of probiotic yoghurt, and greatly activated the bacteiras such as bifidobacterial, lactobacilli bacteria.

3. Conclusion

It is identifiable that the source of functional oil such as fruits, apices added yoghurts are having no significant differences and the total solids content of yoghurt was changed significantly during storage. It is acting as a functional ingredient and provides health benefits such as antimicrobial and anti-tumor effects and is treated for diabetic patients.

References

[1] Adedeji, O., Olafiaji, E., Omole, F., Olanibi, J., & Yusuff, L. (2014). An assessment of the impact of road transport on rural development: A case study of Obokun local government area of Osun State, Nigeria. *British Journal of Environmental Sciences*, *2*(1), 34-48. DOI, https://doi.org/10.53902/gsres.2021.01.000517

[2] Agu, C., Igwe, J., Amanze, N., & Oduma, O. (2016). Effect of oven drying on proximate composition of ginger. *American Journal of Engineering Research*, *5*(8), 58-61. [Available at :https://www.ajer.org/papers/v5(08)/I0508058061.pdf]

[3] Ahlawat, K. S., & Khatkar, B. S. (2011). Processing, food applications and safety of aloe vera products: a review. *Journal of food science and technology*, *48*(5), 525-533. DOI, https://doi.org/10.1007/s13197-011-0229-z

[4] AKIN, S., & KONAR, A. (1999). A Comparative Study of Physicochemical and Organoleptic Qualities of Flavoured Yogurts Made from Cow's and Goat's Milk and Stored for 15 Days. *Turkish Journal of Agriculture and Forestry*, *23*(9), 557-566. [Available at :https://journals.tubitak.gov.tr/agriculture/vol23/iss9/3/]

[5] Al-Taif, R. E. M., Elsayed, I., Awad, S. A., & Alattar, A. M. A. (2022). Evaluation of Chemical, Microbiological and Sensorial Properties of Yoghurt Fortified with Aloe Vera Gel. *Alexandria Science Exchange Journal*, *43*(4), 485-493. DOI, https://doi.org/10.21608/asejaiqjsae.2022.263514

[6] Altuntas, S., & Korukluoglu, M. (2019). Growth and effect of garlic (Allium sativum) on selected beneficial bacteria. *Food Science and Technology*, *39*, 897-904. DOI, https://doi.org/10.1590/fst.10618

[7] Alvarez-Suarez, J. M., Tulipani, S., Romandini, S., Bertoli, E., & Battino, M. (2010). Contribution of honey in nutrition and human health: a review. *Mediterranean Journal of Nutrition and Metabolism*, *3*(1), 15-23. DOI, https://doi.org/10.3233/s12349-009-0051-6

[8] Amadou, A., Waddington Achatz, M. I., & Hainaut, P. (2018). Revisiting tumor patterns and penetrance in germline TP53 mutation carriers: temporal phases of Li–Fraumeni syndrome. *Current opinion in oncology*, *30*(1), 23-29. DOI, https://doi.org/10.1097/cco.0000000000000423

[9] Amal, A., Eman, A., & Nahla, S. Z. (2016). Fruit flavored yogurt: Chemical, functional and rheological properties. *International Journal of Environmental and Agriculture Research*, *2*(5), 57-66. [Available at :https://ijoear.com/assets/articles_menuscripts/file/IJOEAR-MAY-2016-7.pdf]

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

[10] Anal, A. K. (2019). Quality ingredients and safety concerns for traditional fermented foods and beverages from Asia: A review. *Fermentation*, *5*(1), 8. DOI, https://doi.org/10.3390/fermentation5010008

[11] azari-anpar, m., payeinmahali, h., daraei garmakhany, A., & Sadeghi Mahounak, A. (2017). Physicochemical, microbial, antioxidant, and sensory properties of probiotic stirred yoghurt enriched with Aloe vera foliar gel. *Journal of food processing and preservation*, *41*(5), e13209. DOI, https://doi.org/10.1111/jfpp.13209

[12] Benchikh, Y., Aissaoui, A., Allouch, R., & Mohellebi, N. (2021). Optimising anthocyanin extraction from strawberry fruits using response surface methodology and application in yoghurt as natural colorants and antioxidants. *Journal of food science and technology*, *58*(5), 1987-1995. DOI, ttps://doi.org/10.1007/s13197-020-04710-0

[13] Bozzi, A., Perrin, C., Austin, S., & Vera, F. A. (2007). Quality and authenticity of commercial aloe vera gel powders. *Food chemistry*, *103*(1), 22-30. DOI, https://doi.org/10.1016/j.foodchem.2006.05.061

[14] Celik, S., Bakırcı, I., & Şat, I. (2006). Physicochemical and organoleptic properties of yogurt with cornelian cherry paste. *International Journal of Food Properties*, *9*(3), 401-408. DOI, https://doi.org/10.1080/10942910600596258

[15] Chávez-González, M., Rodríguez-Herrera, R., & Aguilar, C. (2016). Essential oils: A natural alternative to combat antibiotics resistance. *Antibiotic Resistance-Mechanisms and New Antimicrobial Approaches; Kon, K., Rai, M., Eds*, 227-237. DOI, https://doi.org/10.1016/b978-0-12-803642-6.00011-3

[16] Christaki, E. V., & Florou-Paneri, P. C. (2010). Aloe vera: a plant for many uses. *J Food Agric Environ*, *8*(2), 245-249. DOI, https://doi.org/10.1016/b978-0-12-814700-9.00002-9

[17] Chrubasik, S., Pittler, M., & Roufogalis, B. (2005). Zingiberis rhizoma: a comprehensive review on the ginger effect and efficacy profiles. *Phytomedicine*, *12*(9), 684-701. DOI, https://doi.org/10.1016/j.phymed.2004.07.009

[18] Cinbas, A., & Yazici, F. (2008). Effect of the addition of blueberries on selected physicochemical and sensory properties of yoghurts. *Food Technology and Biotechnology*, *46*(4), 434-441. https://hrcak.srce.hr/file/48133 DOI, https://doi.org/10.1002/9780470988558.ch7

[19] Crozier, A., Yokota, T., Jaganath, I. B., Marks, S., Saltmarsh, M., & Clifford, M. N. (2006). Secondary metabolites in fruits, vegetables, beverages and other plant based dietary components. *Plant secondary metabolites: Occurrence, structure and role in the human diet*, 208-302. DOI, https://doi.org/10.1002/9780470988558.ch7

[20] Daharia, A., Jaiswal, V. K., Royal, K. P., Sharma, H., Joginath, A. K., Kumar, R., & Saha, P. (2022). A Comparative review on ginger and garlic with their pharmacological Action. *Asian Journal of Pharmaceutical Research and Development*, *10*(3), 65-69. [Available at :http://www.ajprd.com/index.php/journal/article/view/1147]

[21] Devi, P. V., & Brar, D. (2018). Comparison of proximate composition and mineral concentration of Allium ampeloprasum (elephant garlic) and Allium sativum (garlic). *Chem. Sci. Rev. Lett*, *7*, 362-367.[Available at :https://chesci.com/wp-content/uploads/2018/07/V7i25_55_CS202049021_Vivekanandini_362-367.pdf]

[22] Dias, P. I., & Jayasooriya, M. N. (2017). Enhancing the physiochemical and antioxidant properties of stirred yoghurt by incorporating soursop (Annona Muricata). *Int J Life Sci Res*, *5*, 69-77. [Available at: www.researchpublish.com]

[23] Dissanayake, K. G. C., Waliwita, W., & Liyanage, R. (2020). A review on medicinal uses of Zingiber officinale (ginger). *International Journal of Health Sciences and Research*, *10*(6), 142-148. [Available at: https://www.ijhsr.org/IJHSR_Vol.10_Issue.6_June2020/22.pdf]

[24] Dorman, H. D., & Deans, S. G. (2000). Antimicrobial agents from plants: antibacterial activity of plant volatile oils. *Journal of applied microbiology*, *88*(2), 308-316. DOI, https://doi.org/10.1046/j.1365-2672.2000.00969.x

[25] Dziri, S., Casabianca, H., Hanchi, B., & Hosni, K. (2014). Composition of garlic essential oil (Allium sativum L.) as influenced by drying method. *Journal of Essential Oil Research*, *26*(2), 91-96. DOI, https://doi.org/10.1080/10412905.2013.868329

[26] Edris, A. E., & Fadel, H. M. (2002). Investigation of the volatile aroma components of garlic leaves essential oil. Possibility of utilization to enrich garlic bulb oil. *European Food Research and Technology*, *214*(2), 105-107. DOI, https://doi.org/10.1007/s00217-001-0429-2

[27] Fakhri, S., Patra, J. K., Das, S. K., Das, G., Majnooni, M. B., & Farzaei, M. H. (2021). Ginger and heart health: from mechanisms to therapeutics. *Current Molecular Pharmacology*, *14*(6), 943-959. DOI, https://doi.org/10.2174/1874467213666201209105005

[28] Felfoul, I., Borchani, M., Samet-Bali, O., Attia, H., & Ayadi, M. (2017). Effect of ginger (Zingiber officinalis) addition on fermented bovine milk: Rheological properties, sensory attributes and antioxidant potential. *Journal of New Sciences*, *44*(3), 2400-2409. [Available at : https://www.jnsciences.org/agri-biotech/64-volume-44/354-effect-of-ginger-zingiber-officinalis-addition-on-fermented-bovine-milk-rheological-properties,-sensory-attributes-and-antioxidant-potential.html]

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

[29] Ferretti, G., Bacchetti, T., Belleggia, A., & Neri, D. (2010). Cherry antioxidants: from farm to table. *Molecules*, *15*(10), 6993-7005. DOI, https://doi.org/10.3390/molecules15106993

[30] Gangwar, R., Hai, H., Sharma, N., & Kumar, P. (2016). Development and quality evaluation of yoghurt fortified with pineapple, apple and sweet lemon juice (fruit yoghurt). *International Journal of Engineering Research*, *5*(3), 621-629. DOI, https://doi.org/10.17577/ijertv5is030484

[31] Goncagul, G., & Ayaz, E. (2010). Antimicrobial effect of garlic (Allium sativum). *Recent patents on anti-infective drug discovery*, *5*(1), 91-93. DOI, https://doi.org/10.2174/157489110790112536

[32] Gopinathan, S., & Rameela, N. (2014). Anti-ulcer activity of Aloe vera juice and Aloe vera and amla fruit combined juice in ethanol induced ulcerated rats. *International Journal of Pharmacy and Pharmaceutical Sciences*, *6*(6), 190-197. [Available at : https://innovareacademics.in/journal/ijpps/Vol6Issue6/9446.pdf]

[33] Gündoğdu, E., Cakmakci, S., & Dağdemir, E. (2009). The effect of garlic (Allium sativum L.) on some quality properties and shelf-life of set and stirred yoghurt. *Turkish Journal of Veterinary & Animal Sciences*, *33*(1), 27-35. DOI, https://doi.org/10.3906/vet-0704-26

[34] Gutierrez, J., Barry-Ryan, C., & Bourke, P. (2009). Antimicrobial activity of plant essential oils using food model media: efficacy, synergistic potential and interactions with food components. *Food microbiology*, *26*(2), 142-150. DOI, https://doi.org/10.1016/j.fm.2008.10.008

[35] Gutierrez, J., Rodriguez, G., Barry-Ryan, C., & Bourke, P. (2008). Efficacy of plant essential oils against foodborne pathogens and spoilage bacteria associated with ready-to-eat vegetables: antimicrobial and sensory screening. *Journal of food protection*, *71*(9), 1846-1854. DOI, https://doi.org/10.4315/0362-028x-71.9.1846

[36] Harris, J., Cottrell, S., Plummer, S., & Lloyd, D. (2001). Antimicrobial properties of Allium sativum (garlic). *Applied microbiology and biotechnology*, *57*(3), 282-286. DOI, https://doi.org/10.1007/s002530100722

[37] Hom, C., Luo, Y., & Budoff, M. (2015). The effects of aged garlic extract on coronary artery calcification progression. *J Nutr Food Sci S*, *5*, 2. DOI, https://doi.org/10.4172/2155-9600.s5-005

[38] Hossain, M., Fakruddin, M., & Islam, M. N. (2012). Development of fruit Dahi (yoghurt) fortified with strawberry, orange and grapes juice. *American Journal of Food Technology*, *7*(9), 562-570. DOI, https://doi.org/10.3923/ajft.2012.562.570

[39] Hui, Y. H. (1993). Dairy science and technology handbook.

[40] Ikram, A., Qasim Raza, S., Saeed, F., Afzaal, M., Munir, H., Ahmed, A., Babar Bin Zahid, M., & Muhammad Anjum, F. (2021). Effect of adding Aloe vera jell on the quality and sensory properties of yogurt. *Food Science & Nutrition*, *9*(1), 480-488. DOI, https://doi.org/10.1002/fsn3.2017

[41] Israili, Z. H. (2014). Antimicrobial properties of honey. *American journal of therapeutics*, *21*(4), 304-323.

[42] Jadhav, A. S., Patil, O. A., Kadam, S. V., & Bhutkar, M. A. (2020). Review on Aloe Vera is used in medicinal plant. *Asian Journal of Research in Pharmaceutical Science*, *10*(1), 26-30. DOI, https://doi.org/10.5958/2231-5659.2020.00006.5

[43] Kailasapathy, K., Harmstorf, I., & Phillips, M. (2008). Survival of Lactobacillus acidophilus and Bifidobacterium animalis ssp. lactis in stirred fruit yogurts. *LWT-Food Science and Technology*, *41*(7), 1317-1322.DOI, https://doi.org/10.1016/j.lwt.2007.08.009

[44] Katzer, G. (2005). Spice Pages: Garlic (Allium sativum, garlick). In: Retrieved 2007-08-28. [Available at: https://apotheca.myspecies.info/taxonomy/term/242/descriptions]

[45] Kelley, D. S., Adkins, Y., & Laugero, K. D. (2018). A review of the health benefits of cherries. *Nutrients*, *10*(3), 368. DOI, https://doi.org/10.3390/nu10030368

[46] Küçüköner, E., & Tarakçı, Z. (2003). Influence of different fruit additives on some properties of stirred yoghurt during storage. *Yüzüncü Yıl Üniversitesi Tarım Bilimleri Dergisi*, *13*(2), 97-101. [Availlable at : https://dergipark.org.tr/en/download/article-file/204933]

[47] Kumar, K. S., Bhowmik, D., Biswajit, C., & Chandira, M. (2010). Medicinal uses and health benefits of honey: an overview. *J Chem Pharm Res*, *2*(1), 385-395. [Avaiable at: https://www.jocpr.com/articles/medicinal-uses-and-health-benefits-of-honey-an-overview.pdf]

[48] Larasati, B., Panunggal, B., Afifah, D., Anjani, G., & Rustanti, N. (2018). Total lactic acid bacteria, antioxidant activity, and acceptance of synbiotic yoghurt with red ginger extract (Zingiberofficinale var. rubrum). IOP Conference Series: Earth and Environmental Science, DODI, https://doi.org/10.1088/1755-1315/116/1/012037

[49] Lawless, J. (2000). The chemical composition of Aloe vera. *Aloe vera natural wonder cure*, 161-171.

[50] Lewis, M. (2003). Improvements in the pasteurisation and sterilisation of milk. *Dairy Processing: Improving Quality*, 81-103. DOI, https://doi.org/10.1533/9781855737075.1.81

[51] Lutchmedial, M., Ramlal, R., Badrie, N., & Chang-Yen, I. (2004). Nutritional and sensory quality of stirred soursop (Annona muricata L.) yoghurt. *International journal of food sciences and nutrition*, *55*(5), 407-414. DOI, https://doi.org/10.1080/09637480400002800

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

[52] Mahmood, A., Abbas, N., & Gilani, A. (2008). Quality of stirred buffalo milk yogurt blended with apple and banana fruits. *Pakistan Journal of Agricultural Sciences*, *45*(2), 275-279. [Available at:; https://pakjas.com.pk/papers/198.pdf]

[53] Mansour, A. I. A., El-Loly, M. M., & Ahmed, R. O. (2012). A preliminary detection of physical and chemical properties, inhibitory substances and preservatives in raw milk. *Reading*, *4*(0.14). DOI, https://doi.org/10.21608/avmj.2006.177635

[54] McClure, C., & Nolan, L. L. (1995). Herb extracts as potential antiprotozoal agents. International Symposium on Medicinal and Aromatic Plants 426,DOI, https://doi.org/10.17660/actahortic.1996.426.10

[55] Mikołajczak, N. (2018). Potential health benefits of Aloe vera. *Journal of Education, Health and Sport*, *8*(9), 1420-1435. DOI, https://doi.org/10.12775/jehs.2022.12.10.001

[56] Mootoosamy, A., & Mahomoodally, M. F. (2014). Ethnomedicinal application of native remedies used against diabetes and related complications in Mauritius. *Journal of ethnopharmacology*, *151*(1), 413-444. DOI, https://doi.org/10.1016/j.jep.2013.10.069

[57] Nazari, M., Ghanbarzadeh, B., Kafil, H. S., Zeinali, M., & Hamishehkar, H. (2019). Garlic essential oil nanophytosomes as a natural food preservative: Its application in yogurt as food model. *Colloid and interface science communications*, *30*, 100176. DOI, https://doi.org/10.1016/j.colcom.2019.100176

[58] Odebunmi, E., Oluwaniyi, O., Awolola, G., & Adediji, O. (2009). Proximate and nutritional composition of kola nut (Cola nitida), bitter cola (Garcinia cola) and alligator pepper (Afromomum melegueta). *African Journal of Biotechnology*, *8*(2). [Available at : http://www.academicjournals.org/AJB]

[59] Oliveira, A., Alexandre, E. M., Coelho, M., Lopes, C., Almeida, D. P., & Pintado, M. (2015). Incorporation of strawberries preparation in yoghurt: Impact on phytochemicals and milk proteins. *Food chemistry*, *171*, 370-378. DOI, https://doi.org/10.1016/j.foodchem.2014.08.107

[60] Organization, W. H. (2005). *The World health report: 2005: make every mother and child count*. World Health Organization. DOI, https://doi.org/10.1080/14034940500217037

[61] Ozogul, Y., Boğa, E. K., Akyol, I., Durmus, M., Ucar, Y., Regenstein, J. M., & Köşker, A. R. (2020). Antimicrobial activity of thyme essential oil nanoemulsions on spoilage bacteria of fish and food-borne pathogens. *Food Bioscience*, *36*, 100635. DOI, https://doi.org/10.1016/j.fbio.2020.100635

[62] Öztürk, B., & Öner, M. (1999). Production and evaluation of yogurt with concentrated grape juice. *Journal of food science*, *64*(3), 530-532. DOI, https://doi.org/10.1111/j.1365-2621.1999.tb15077.x

[63] Panesar, P. S., & Shinde, C. (2012). Effect of storage on syneresis, pH, Lactobacillus acidophilus count, Bifidobacterium bifidum count of Aloe vera fortified probiotic yoghurt. *Current research in dairy sciences*, *4*(1), 17-23. DOI, https://doi.org/10.3923/crds.2012.17.23

[64] Pratap, Y. S. M., Chandra, R., Shukla, S., & Ali, M. N. (2016). Optimization of the chemical properties of frozen yoghurt supplemented with different fruit pulp. *The Pharma Innovation*, *4*(2, Part B). [Available at:; https://www.thepharmajournal.com/archives/2015/vol4issue2/PartB/4-2-34.pdf]

[65] Prowse, G. M., Galloway, T. S., & Foggo, A. (2006). Insecticidal activity of garlic juice in two dipteran pests. *Agricultural and Forest Entomology*, *8*(1), 1-6. DOI, https://doi.org/10.1111/j.1461-9555.2006.00273.x

[66] Rajeswari, R., Umadevi, M., Rahale, C. S., Pushpa, R., Selvavenkadesh, S., Kumar, K. S., & Bhowmik, D. (2012). Aloe vera: the miracle plant its medicinal and traditional uses in India. *Journal of Pharmacognosy and Phytochemistry*, *1*(4), 118-124. [Available at: https://www.phytojournal.com/vol1Issue4/Issue_nov_2012/17.1.pdf]

[67] Rehman, T., & Fatima, Q. (2018). Ginger (Zingiber officinale): A Mini review. *Int J Complement Alt Med*, *11*(2), 88-89. DOI, https://doi.org/10.15406/ijcam.2018.11.00373

[68] Rivlin, R. S. (2001). Historical perspective on the use of garlic. *The Journal of nutrition*, *131*(3), 951S-954S. DOI, https://doi.org/10.1093/jn/131.3.951s

[69] Rounds, L., Havens, C. M., Feinstein, Y., Friedman, M., & Ravishankar, S. (2012). Plant extracts, spices, and essential oils inactivate Escherichia coli O157: H7 and reduce formation of potentially carcinogenic heterocyclic amines in cooked beef patties. *Journal of agricultural and food chemistry*, *60*(14), 3792-3799. DOI, https://doi.org/10.1021/jf204062p

[70] Sachan, A., Kumar, S., Kumari, K., & Singh, D. (2018). Medicinal uses of spices used in our traditional culture: Worldwide. *Journal of Medicinal Plants Studies*, *6*(3), 116-122. [Available at: https://www.researchgate.net/publication/342591176]

[71] Saini, M., Goyal, P. K., & Chaudhary, G. (2010). Anti-tumor activity of Aloe vera against DMBA/croton oil-induced skin papillomagenesis in Swiss albino mice. *Journal of Environmental Pathology, Toxicology and Oncology*, *29*(2). DOI, https://doi.org/10.1615/jenvironpatholtoxicoloncol.v29.i2.60

[72] Sajid, M., Butt, M. S., Shehzad, A., & Tanweer, S. (2014). Chemical and mineral analysis of garlic: a golden herb. *Pak. J. Food Sci*, *24*(1), 108-110. [Available at: https://www.cabdirect.org/cabdirect/abstract/20143313195]

ISSN: 2309-5288 (Print)
ISSN: 2309-6152 (Online)
CODEN: JCLMC4
Journal of Coastal Life Medicine

[73] Saleh, I., Abdelwahed, E., Rabie, A., & El-Ella, A. (2018). FORTIFICATION OF PROBIOTIC STIRRED YOGHURT BY ADDITION OF APPLE AND MANGO PULPS. *Zagazig Journal of Agricultural Research*, *45*(2), 625-635. DOI, https://doi.org/10.21608/zjar.2018.49185

[74] Samadiy, M., & Deng, T. (2021). Lithium Recovery from Water Resources by Ion Exchange and Sorption Method. *Journal of the Chemical Society of Pakistan*, *43*(4). DOI, https://doi.org/10.52568/000585

[75] Sarkar, S., & Chandra, S. (2019). Honey as a functional additive in yoghurt–a review. *Nutrition & Food Science*, *50*(1), 168-178. DOI, https://doi.org/10.1108/nfs-03-2019-0090

[76] Senadeera, S., Prasanna, P., Jayawardana, N., Gunasekara, D., Senadeera, P., & Chandrasekara, A. (2018). Antioxidant, physicochemical, microbiological, and sensory properties of probiotic yoghurt incorporated with various Annona species pulp. *Heliyon*, *4*(11), e00955. DOI, https://doi.org/10.1016/j.heliyon.2018.e00955

[77] Sfakianakis, P., & Tzia, C. (2014). Conventional and innovative processing of milk for yogurt manufacture; development of texture and flavor: a review. *Foods*, *3*(1), 176-193. DOI, https://doi.org/10.3390/foods3010176

[78] Shahrajabian, M. H., Sun, W., & Cheng, Q. (2019). Clinical aspects and health benefits of ginger (Zingiber officinale) in both traditional Chinese medicine and modern industry. *Acta agriculturae scandinavica, section b—Soil & Plant Science*, *69*(6), 546-556. DOI, https://doi.org/10.1080/09064710.2019.1606930

[79] Shukla, Y., & Singh, M. (2007). Cancer preventive properties of ginger: a brief review. *Food and chemical toxicology*, *45*(5), 683-690. DOI, https://doi.org/10.1016/j.fct.2006.11.002

[80] Smit, G. (2003). *Dairy processing: improving quality*. Elsevier.

[81] Strika, I., Bašić, A., & Halilović, N. (2017). Antimicrobial effects of garlic (Allium sativum L.). *Bulletin of the Chemists and Technologists of Bosnia and Herzegovina*, *47*(7), 17-20. DOI, https://doi.org/10.1016/j.fct.2006.11.002

[82] Taormina, P. J., Niemira, B. A., & Beuchat, L. R. (2001). Inhibitory activity of honey against foodborne pathogens as influenced by the presence of hydrogen peroxide and level of antioxidant power. *International journal of food microbiology*, *69*(3), 217-225. https://doi.org/10.1016/s0168-1605(01)00505-0

[83] Tsao, R., & Li, H. (2016). Strawberry Juice. In *Handbook of Functional Beverages and Human Health* (pp. 565-576). CRC Press. Available at: https://www.researchgate.net/profile/H-P-Vasantha-Rupasinghe/publication/301340362_Apple_juice/links/5712a21008aeff315ba0d7df/Apple-juice.pdf

[84] Tyowua, A. T., Abel, O. O., Adejo, S. O., & Mbaawuaga, M. E. (2022). Functional Properties of Emulsified Honey–Vegetable Oil Mixtures. *ACS Food Science & Technology*, *2*(3), 581-591. DOi, https://doi.org/10.1021/acsfoodscitech.1c00475

[85] Wedad A, M., Ratiba B, A., OE, M., & HMA, A. B. (2007). Effect of adding cardamom, thyme and clove essential oils on some properties of white soft cheese made from goats' milk. DOI, https://doi.org/10.21608/ajfs.2007.19629

[86] Wen Li, Liyuan Yun, Mohamed Rifky, Rui Liu, Tao Wu, Wenjie Sui, Min Zhang,(2021), Carboxymethylation of (1 → 6)-α-dextran from Leuconostoc spp.: Effects on microstructural, thermal and antioxidant properties, International Journal of Biological Macromolecules, 166(1), 1-8, DOI, https://doi.org/10.1016/j.ijbiomac.2020.11.114

[87] Wu, T., Liu, R., Zhang, L., Rifky, M., Sui, W., Zhu, Q., ... & Zhang, M. (2022). Dietary Intervention on Depression-A review. *Food & Function*., 13(1), 12475-12486

[88] https://doi.org/10.1039/D2FO02795J

[89] Xiao, J., Wang, J., Yuan, F., Pan, X., Samadiy, M., Deng, T., & Guo, Y. (2022). Volumetric properties of the binary aqueous system lithium metaborate from 283.15 to 363.15 K and 101 kPa: Experimental and thermodynamic model. *Journal of Molecular Liquids*, *366*, 120174.

[90] https://doi.org/10.1016/j.molliq.2022.120174

[91] Xie, Y., Zhang, Y., Qin, J., Samadiy, M., & Deng, T. (2022). Synthesis of Spherical Composite CMC-LTO-EGDE-ME for Lithium Recovery from Geothermal Water. *Journal of Chemistry*, *2022*.

[92] https://doi.org/10.1155/2022/6884947.

[93] Yadav, A. K., Singh, A., & Yadav, K. C. (2018). Efficacy of flavored Aloe vera cubes in probiotic yogurt. *Journal of Pharmacognosy and Phytochemistry*, *7*(4), 1609-1614. [Available at: https://www.phytojournal.com/archives/2018/vol7issue4/PartAA/7-4-122-983.pdf]

[94] Yook, H.-S., Kim, K.-H., Park, J.-E., & Shin, H.-J. (2010). Antioxidative and antiviral properties of flowering cherry fruits (Prunus serrulata L. var. spontanea). *The American journal of Chinese medicine*, *38*(05), 937-948. DOI, DOI, https://doi.org/10.1142/s0192415x10008366

[95] Zhao, Y., Liu, R., Qi, C., Li, W., Rifky, M., Zhang, M., Xiao, P., Wu, T., & Sui, W. (2021). Mixing oil-based microencapsulation of garlic essential oil: impact of incorporating three commercial vegetable oils on the stability of emulsions. *Foods*, *10*(7), 1637. DOI, https://doi.org/10.3390/foods10071637