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Comparing the microbial quality of traditional and industrial yoghurts

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ABSTRACT

The matrix of milk with high water activity (a_w) and neutral pH characterized as a suitable culture for an extensive variety of microbial strains. In this regard, both pathogenic bacteria and fungi are recognized as a main microbial agent that significantly contaminated milk-based products especially yoghurt. Microbial contamination is the most common worry of yoghurt safety that they can effect on the host's healthiness status. The presence of fungi (molds and yeasts) especially *Geotrichum candidum* (milk mold) in industrial yoghurt and on the equipment of factory is the indicator of weak hygienic situation in producing and packing systems. Some studies have shown that the contamination in traditional yoghurts was greater than industrial ones. Aflatoxins are a cluster of metabolites of molds produced via some toxicogenic strains of Aspergillus such as *A. flavus*, *A. nomius* and *A. parasiticus* foodstuffs. Aflatoxin B1 is the most common mycotoxin in the yoghurt. There is a straight connection between the AFM_1 existence in the product and the hazard of diseases in consumers. Accordingly, it is essential to inform fabricators and consumers about the contamination of product to decrease their possible healthiness hazards and commercial concerns. This paper provides an overview of the hygienic quality, presence of Aflatoxins, probiotics, and comparison of the microbial quality in both traditional and industrial yoghurts.

Keywords: *Microbial quality; Traditional yoghurt; Industrial yoghurt; Yoghurt; Hygienic quality.*

1. INTRODUCTION

Yogurt is one of the most specific fermented milk-based products and it has been used in many countries since ancient times as the main milk fermentation product Yoghurt obtains this reputation via conferring several of the elemental nutrients imperative for consumer healthiness [2, 3]. The presence of pathogenic microorganisms in milk and dairy products especially in yoghurt has been a serious concern of public health issues because yoghurt is one of the most consumed dairy products in the world. It is important to note that the establishment unhygienic conditions in milk products processing are one of the major reasons that lead to many infections and/or diseases such as tuberculosis, diphtheria, brucellosis, scarlet fever, Q fever, and gastroenteritis [2, 4]. In fact, the microbial feature of yoghurt shows the feature of the raw milk [5]. Main pathogenic and spoiler microorganisms in dairy products are; gram-negative psychrotrophs (such as Pseudomonas, Alcaligenes, Moraxella, and Acinetobacter), coliforms and lactic acid bacteria. Besides, *Listeria monocytogenes*, *Yersinia enterocolitica*, *Salmonella* sp., *Campylobacter jejuni*, enterotoxigenic strains of *Staphylococcus aureus*, and pathogenic strains of *Escherichia coli* may be found in milk-based products [6]. In the intervening time, probiotic yoghurt is a functional foodstuff that has valuable effects on consumer healthiness [7]. The word, probiotic meaning ‘for life’, is isolated from the Greek tongue. The matrix of foods may affect the activity, survival, and effectiveness of microorganisms so merits attention [8].

Constipation is the most common gastrointestinal (GI) disorders that may be inhibited through regular consumption of probiotic yoghurt [9]. The associated health claims range from the improvement of signs of lactose intolerance, reducing blood cholesterol, diarrhea, and cancer suppression 9, 10]. Nevertheless, hygienic and sanitary conditions of processing are necessary for the fabrication of safe and good quality product. Even slight microbial contamination may perhaps decline the quality of yoghurt also may possibly have undesirable influences on consumer’s healthiness [11, 12]. The main purpose of this study is the comparison of the microbial quality of traditional and industrial yoghurts.

2. HYGIENIC QUALITY OF YOGHURT

2.1. Traditional yoghurts.

Although scientific reports recommended that have a direct association between drink unpasteurized milk and gastrointestinal infections, some consumers choose to drink it. The process of traditional yoghurt production was schematically presented in Fig.1 [13]. The milk after milking has a short shelf life, however, other milk-based products such as yoghurt can last for a month. Consequently, based on product dissemination and the incidence of contamination, the infections related to raw milk can be frequently distributed in time and place [14]. *E. coli* O157: H7 has been separated from raw milk samples and may be transmitted to consumers through consumption unpasteurized milk or other dairy products [14, 15]. The temperature of the fermentation process and packing are key elements that influence the viability of *E. coli* O157: H7 in the traditional yoghurt. This gram-negative bacterium can live and growth through the fermentation process of traditional yoghurt with low lactose but the growth of it can be inhibited via industrial yoghurt production circumstances [14]. Yeasts and molds may be existing in the matrix of traditional yoghurts because of poor hygienic situations of milking and storing, inappropriate heating, and secondary contamination. Milk is a suitable culture for the spread of a wide variety of pathogens. Great counts of yeasts and molds in various samples disclosed unacceptable hygienic situations throughout fermentation process and post-production. Therefore, authorities should pay more attention to management on refining health conditions for the production of such dairy products [16, 17].

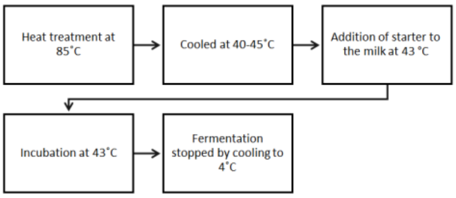

Figure 1. The schematic procedure for traditional yoghurt manufacturing.

2.2. Industrial yoghurts.

The primary industrial fabrication of yoghurt was happened in 1919, in Barcelona, Spain at a firm named Danone (18).

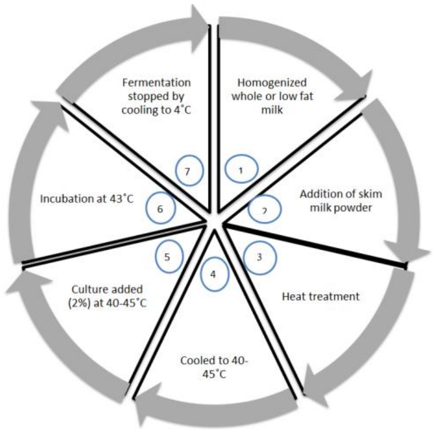

Figure 2. The schematic procedure for industrial yoghurt manufacturing.

The process of industrial yoghurt producing was schematically displayed in Fig. 2 [13, 19]. The presence of fungi in this form yoghurts is an indicator of poor sanitary performs in the production. Aflatoxin B1 (AFB_1) is a well-known mycotoxin secreted via various species of Aspergillus which leads to the main grade of toxicity. The creation of AFM_1, a metabolite of AFB1, takes place in the liver tissue and it is excreted by the gland of mammary of dairy cows and when this milk was used to yoghurt manufacturing, AFM_1 may be transferred into the yoghurt matrix [20, 21]. Thus it is essential to attention on levels of feed fabrication intended for cows in addition to the manufacture situation of the factory. To inhibit AF occurrences, it is compulsory to interconnect about the possible hazards of husbandry supervisions that could contaminate foods and feeds [22].

2.3. The existence of AFM1 in the matrix of traditional and industrial yoghurt.

Aflatoxins are recognized as a cluster of toxic secondary metabolites of molds that usually secreted via different strains of Aspergillus such as; *A. flavus*, *A. parasiticus* and *A. nomius* in a wide range of farming supplies. The result of studies demonstrated that they are very toxic, teratogenic and mutagenic compounds and the main reason for hepatic and extra-hepatic carcinogenesis between the four recognized types of AFB1, AFB2, AFG1, and AFG2. Among these types of aflatoxins, AFB_1 is the most common made mycotoxin and has been reported to be the most powerful regular carcinogen in human and animals [23, 24]. The International Agency for Research on Cancer (IARC) consists of AFM_1 in group 1 cancer-causing toxins. AFM_1 is a mono hydroxylated form of AFB_1 that metabolized by cytochrome P450 enzyme system in the liver and ejected into the milk of lactating cattle which spent AFB_1 contaminated diet. Around 0.5-5% of AFB_1 present in livestock feed pass as AFM_1 in milk [25]. This changeability AFB_1 present in animal feed is because of diverse objects for instance stage lactation, ingesting of AFB_1 and diverse retorts. The toxicity of AFM_1 is significantly less than its parental complex, AFB_1; nevertheless, the genotoxic, cytotoxic, and carcinogenic influences of it are well recognized (26). In recent decades many investigations focused on the association between season and aflatoxin M1 presence. Researches on the contamination rate of AFM1 was shown in Table (1). Raeyat et al., (2016) reported contamination of raw milk by means of AFM1 at hazardous levels for human health [27]. When dairy products are fabricated via milks contaminated with AFM_1, the toxin may perhaps be identified in the samples. Inappropriately, the existence of continues somewhat firm throughout the processing and storing of several dairy products for example yoghurt. AFM1cannot be deactivated by modern processing applied in the dairy industry, for instance, sanitization treatments and/or pasteurization [26]. The contamination incidence of pasteurized milk via AFM_1 was showed in Table 2.

A number of countries have verdict acceptable points of AFM_1 in milk and dairy products to defend consumer's healthiness, predominantly children. The US Food and Drug Management (FDA) recommended a limit of 0.05 mg/L as the exploit level for AFM_1 in milk. However, the Institute of Standards and Industrial Research of Iran (ISIRI) has accepted 0. 5 mg/l as the exploit level for AFM_1 which is analogous to European Commission (EC) permitted level [25]. Some investigations have been started to control the prevalence of AFM_1 in milk and other dairy products [26]. Nilchian (2012) determined that the occurrence of AFM_1 in yoghurt was lesser than cheese nonetheless it is greater than ice-cream [28]. Increases of AFM_1 content in dairy products can be in connection with this contamination in milk. In another similar study, Govaris (2002) showed that AFM_1 is more unchanging in the yoghurts with pH 4.6 than pH 4.0 throughout refrigerated storage [29]. According to Teymori et al (2014), 23% of yoghurt samples were contaminated with un-wanted microbes. It is important to govern the critical control points (CCPs) of programmed control methods to remove and diminish the menace of contamination [30].

2.4. Probiotics in yoghurt.

A microorganism can be labeled as probiotic if it attains the following standards (Rad et al., 2012); 1) the culture of microorganism can be fabricated on an industrial scale; 2) the culture of microorganism can alive throughout manufacture and storing; 3) the culture of microorganism can bear the GI circumstance of the host; and 4) the culture of microorganism employ healthy influences once consumed. Routes through which probiotic microorganisms may be effective in relieving diarrhea was schematically shown in Fig. 3 [31]. Traditional yoghurt was the leading food to customers with probiotic microorganisms. The effectiveness of probiotic microorganisms is mostly based on two aspects; survivability and activity in (food products and supplements, and also during passage in GI tract. The suggested ingestion total count of the probiotic microorganisms must be bigger than 10^7 CFU/g of a product to improve the host healthiness [32]. A number of reasons counting probiotic strain, pH of the matrix of the food as a carrier, the nutritive ingredients of the carrier, furthermore heat treatment can affect the survivability and activity of probiotic microorganisms [33, 34].

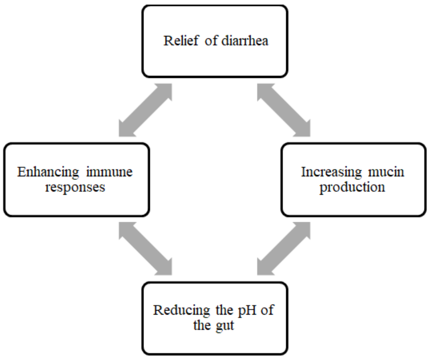

Figure 3. Routes through which probiotics may be effective in alleviating diarrhea [31].

Nevertheless, both supplements and foods appear to have been effectual transporters for the beneficial microorganisms, to largely support public health, probiotic foodstuffs look to be chosen to probiotic supplements. This can be a result of the buffering characteristics of foodstuffs for probiotic microorganisms through passage over the GI tract, provision of essential nutrients for keeping the activity and influence of the probiotic microorganisms, synergistic impacts of food components on probiotic growing as well as user attitude toward probiotic products versus supplementation via capsules and other drug forms [35, 36]. Probiotic microorganisms cloud be combined alone to the milk for the manufactory of probiotic yoghurt. Probiotic yoghurt consumption improves immune-related illnesses, and reduce total cholesterol and LDL-C concentrations in type-2-diabetic people and constipation and also nonalcoholic fatty liver syndrome [7, 37-40]. Some studies have revealed that the counts of *L. acidophilus* and *B. lactis* were 10^6 - 10^7cfu/g in industrialized probiotic yoghurts (7). Also, Mortazavian *et al.*, (2012) reported that yoghurt may have 10^6-10^7 CFU/g of probiotic bacteria [41].

2.5. Probiotics and aflatoxin M1

Milk and milk-based foodstuffs are the main constituent in the consumers' diet, particularly for kids. Consequently, the presence of AFM1 in milk and milk-based foodstuffs must be monitored scientifically [42,43]. Industrial yoghurt commonly produced from cow milk in dairy manufacturing, whereas traditional yoghurt commonly prepared from goat and sheep milk or a mixture of them in farms or small dairy factories. Fallah et al (2011) determined that the rate and level of AFM1 in the matrix of industrial yoghurt were higher than the traditional yoghurt due to the higher incidence of the toxin metabolites in the cow milk than goat and sheep milk. Also, they suggested that the levels of the toxin metabolites in the matrix of industrial yoghurt samples achieved in autumn and winter were meaningfully higher than those achieved in spring and summer. In the instance of traditional yoghurt, the level of AFM1 was meaningfully higher in winter than at other times (20). On the other hand, probiotics and lactic acid bacteria (LAB) are widely applied in food fermentation and preservation (44). Montaseri (2014) showed that the high amounts of probiotic count in culture results in lowering the AFM1 level in the final product (45). Also, Elsanhoty *et al* (2014) pointed out that the possibility of using some strains of lactic acid bacteria (LAB) and Bifidobacteria in detoxification of AFM1-contaminated foods [46,47].

Therefore, it is suggested for the dairy manufacturing and food safety organizations, particularly in areas with high-level pollution of milk by AFM1, to screen the initial milk in yoghurt manufacturing as well as to use the probiotic starter culture in yoghurt production [43,48]. Consequently, it is vital to advise fabricators and customers about the potential toxicity of aflatoxins, to reduce their possible health risks in addition to financial concern. Nevertheless, the organization of official training programmers must be considered by the administration [43,49].

Table 1. Researches on contamination rate of AFM1 in raw milk**.**

Province	Contamination rate (ng/l)	Description	Referents
Hamedan	5-100	The contamination rate of AFM1 in winter was more than in summer.	**[50]**
Ardabil	4-112.4	The lowest and highest levels of contamination were in autumn and winter, respectively.	**[51]**
Babul	4-352.3	The highest rate of contamination was observed in the winter	**[52]**
Sarab	15-280	The amount of contamination in the autumn and winter was more than spring and summer	**[53]**
shiraz	30-7500	Contamination of raw milk spring< winter< autumn< Summer	**[54]**

Table 2. Aflatoxin M1 contamination in pasteurized milk samples.

province	Exceeded limit EC/Codex	Analysis method	Referents
Ardabil	33%	ELISA	**[55]**
Mashhad	5.4%	ELISA	**[56]**
Shahrekord	41.66%	ELISA	**[57]**

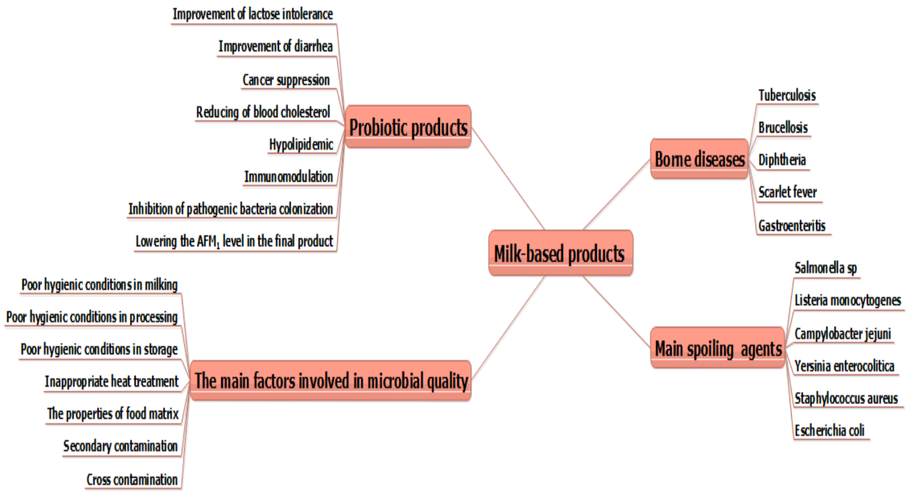

Figure 4. The summary of microbial quality of milk-based product.

3. COMPARISON OF THE MICROBIAL QUALITY OF TRADITIONAL AND INDUSTRIAL YOGHURTS

Industrial yoghurt commonly prepared from fresh cow milk in dairy manufacturing, nonetheless traditional yoghurt commonly made from goat and sheep milk [58,59] Dardashti (2001) claimed that the level of bacterial pollution in traditional processing via coliform was higher than in industrial processing. It also concluded that *E. coli* was not isolated from industrial samples but 1.3% of traditionally prepared yoghurts, contaminated via *E. coli* in all points of yoghurt making. In this regard, the contamination through yeast and mold in the manufacturing process was low whereas in the traditional manufacturing process were noteworthy in all stages of processing [60]. Despite the low pH in the final yoghurt's product, post-processing contamination is one of the main factors that can influence the microbial quality in both traditional and industrial yoghurts. The Summary of microbial quality of milk-based products was schematically shown in Fig.4. The starter cultures applied in yoghurt preparation usually contaminated via yeasts which have potentiated to growth in a food matrix with undesirable conditions. According to Dardashti (2001), the manufacturing stage of yoghurt in the incubation area could be the main residence of contamination. As a consequence, it can be determined that the higher level of contamination in the traditional manufacturing process of yoghurt shows inadequate and lowly sanitary conditions of this technique and the necessity for improvement in the manufacturing plants [61].

4. CONCLUSIONS

The conclusion of this manuscript indicated that some of the various types of yoghurts in the sale shelves may not have suitable microbial features in developing nations. This recommends that it is essential to apply stringent hygienic functions during fabrication, and delivery of yoghurts to avoid contamination with unwelcome components and microorganisms. The principal function in this regard is to encourage customers to intake industry manufactured yoghurts instead of traditional ones. Regularly inspection must be performed via producers in the food industry particularly in the dairy part to detect and improve the lowly hygiene conditions and to apply sanction proceedings where required. It is the producer's responsibility to explain their staff about the necessity of sanitary and hygienic principles as well as factors controlling the shelf-life of pasteurized milk-based products. The shelf-life of milk products is greatly related to the primary quality of raw milk and succeeding in carrying and storage situations. The shelf-life status may be enhanced through applying deep cooling process on milk instantaneously after milking and by using thermization when the milk arrives into the manufacturing unit. Post-contamination via gram-negative psychotropic bacteria is the main cause of the limited shelf-life of pasteurized dairy products. In milk-based products, yeast and mold, contamination is the most cause of decay that must be avoided. Paying consideration to the mentioned actions are recommended to apply new practices to overcome the cross condition is ready to eat yoghurt via promoting the fermentation, and application of hurdle technology as well as good probiotic cells in the fermented dairy products.

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