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Presence, changes and technological properties of yeast species during processing of pastirma, a Turkish dry-cured meat product

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ABSTRACT

In this study, alterations in yeast dynamics during pastirma processing, and technological (growth at different pH, temperature and NaCl conditions, lytic and enzymes activity) properties of yeast strains were investigated. The pH values of pastirma samples increased throughout pastirma processing, while moisture and water activity (a_w) decreased. Initial yeast population decreased from 4.42 log cfu/g to 3.61 log cfu/g during the curing process. Considering the genotypic identification, a total of 100 isolates were obtained from pastirma samples. The dominant yeast species was *Candida zeylanoides* (58%) which was followed by *Candida deformans* (12%) and *Candida galli* (11%), respectively. These yeast species were found at all sampling points. *Trichosporon japonicum* (2%), *Cryptococcus curvatus* (1%) *and Debaryomyces hansenii* (1%) were the least frequent species isolated from the pastirma samples. *C. zeylanoides* and *T. japonicum* did not show any proteolytic activity, and their lipolytic activity was weak. Twenty-one of the yeast isolates had nitrate reductase activity.

1. Introduction

Pastirma, which is classified as an intermediate moisture meat product, is the most popular dry-cured meat product in Turkey (Aksu, Aktas, & Kaya, 2002; Yagli & Ertas, 1998). It is produced from muscles such as *Longissimus dorsi* and *Musculus semimembranosus* obtained from beef or water buffalo (Ahhmed et al., 2013; Aksu et al., 2002). Pastirma production is widely concentrated in the province of Kayseri, located in the middle of Anatolia region of Turkey (Ahhmed et al., 2013; Yagli & Ertas, 1998). There are different pastirma types that are obtained from different parts of the animal, namely şekerpare, kusgomü, bohça, kürek and sırt. Physicochemical, textural and microbiological properties of pastirma differ depending on the origin of the muscle (Kaban, 2013). Several biochemical reactions (such as proteolysis, lipolysis, etc.) occur during pastirma processing which contribute to the aroma and textural properties of pastirma (Kaban, 2009). In pastirma manufacturing, whole muscles purged from exterior fat and connective tissue are cured with some curing agents such as salt, nitrate, nitrite and then it is dried, pressed and coated with paste known as çemen which is composed of garlic, red pepper, paprika and fenugreek (*Trigonella foenum-graecum*) (Gok, Obuz, & Akkaya, 2008). Çemen paste gives pastirma a pleasant flavor and aroma (Yetim, Sagdic, Dogan, & Ockerman, 2006). Pastirma is considered as a safe meat product due to its low water activity and moisture. Thus, most of microorganisms cannot survive in this meat product. Çemen paste also helps with the preservation of pastirma against the growth of some microorganisms such as mold and bacteria on the surface. Pastirma microbiota is substantially inactivated due to the curing process, and low water activity resistant yeasts can survive up to the stage of the çemen paste treatment because of their resistance to low water activity and high salt concentration compared to bacteria. It was demonstrated that lactic acid bacteria (LAB) and catalase positive staphylococci (CPS) are also resistant and able to survive during pastirma processing (Aksu & Kaya, 2002; Kaban, 2009). Yeasts can contaminate foods by different sources such as the air, floor, wall, equipment, hands and apron during food processing (Welthagen & Viljoen, 1999). Because of the tolerance of yeasts to high-osmotic and low-pH conditions and low refrigeration temperatures, they are capable of causing spoilage in physical, chemical, and organoleptic properties of foods (Arias, Burns, Friedrich, Goodrich, & Parish, 2002). Spoilage of foods by yeasts can cause considerable economic losses throughout processing, preservation and storage (Hierro, González, Mas, & Guillamón, 2004). In contrast, yeasts also play very important roles in production of some fermented foods and alcoholic beverages such as bread, beer and wine and contribute to their flavor and aroma due to their lipolytic and proteolytic activities. Similarly yeasts may

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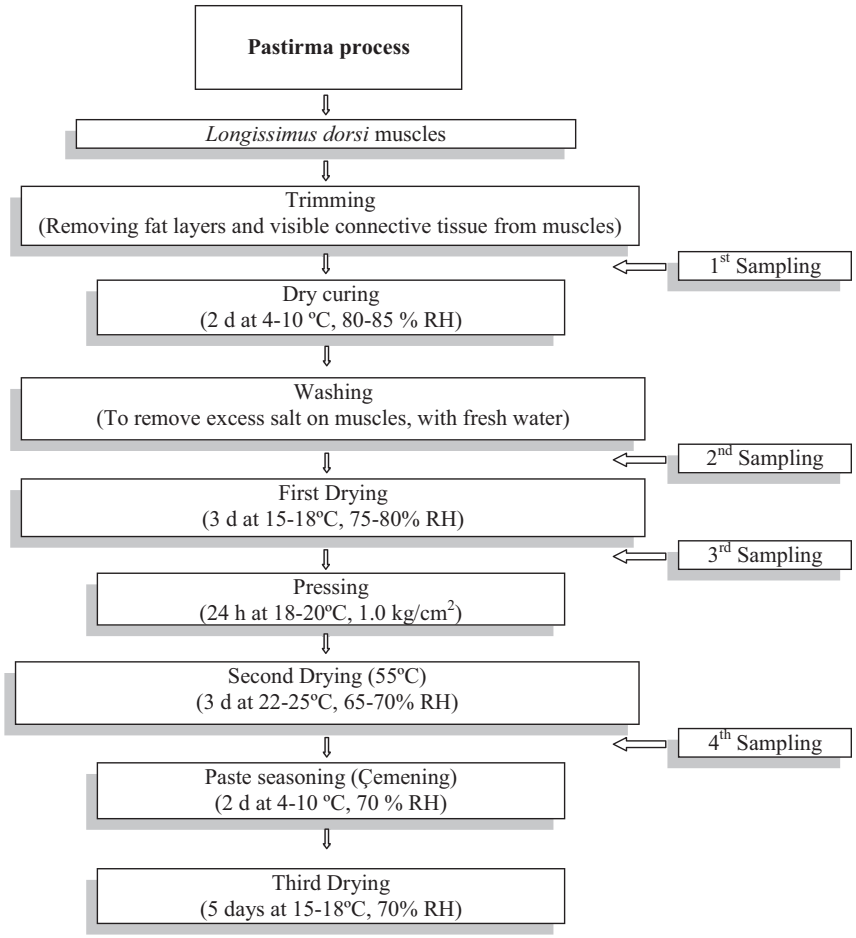

Fig. 1. Pastirma production process.

inhibit or eliminate undesired microorganisms during fermentation due to their antifungal and antibacterial activity (Minervini et al., 2001; Roostita, Fleet, Wendry, Apon, & Gemilang, 2011). Yeasts are considered as secondary starter cultures in some fermented foods such as cheese, sausage and olive (Romano, Capece, & Jespersen, 2006). But the difficulties for the growth control of the yeasts during fermentation process can be an important problem and overgrowth of yeasts may cause significant sensorial and textural changes in these products (Fleet, 1992; Welthagen & Viljoen, 1999). Previously, several studies focused on changes in LAB and CPS counts and chemical characterization of pastirma during pastirma processing, but to the best of our knowledge, the role of yeasts in pastirma processing and their identification have not been studied yet.

The aims of this study were as follows: (i) Identify yeast dynamics of pastirma by molecular methods throughout traditional Turkish pastirma processing, and (ii) characterize some technological (pH, NaCl and temperature resistance, nitrate reductase, proteolytic, lipolytic) properties of yeasts isolated from Turkish pastirma at different process stages.

2. Materials and methods

2.1. Production and sampling of pastirma

In this study, five different *L. dorsi* muscles were obtained from five different cattle (Charolais) that were 3 years old and were used in pastirma production and 5 lots of pastirma (they were sampled as P1, P2, P3, P4 and P5) were produced using traditional methods in a pastirma factory established in Kayseri, Turkey. Four sampling points during the processing were selected: (S1): After removing fat and connective tissues from meat surface, raw material; (S2): after curing and washing; (S3): after first drying and (S4): after second drying. However, after the paste seasoning (Çemening) process, sampling was not conducted because of the possible yeast contamination that can be resulted from the raw materials used in çemen paste formulation. Fig. 1 shows the production flow chart of Turkish pastirma. For dry curing of pastirma, curing mix included 65 g NaCl, 0.100 g KNO_2 and 0.6 g dextrose per kg of meat. The seasoning mixture (çemen paste) was composed of 500 g flour ground from fenugreek (*T. foenum-graecum*) seed, 350 g mashed fresh garlic, 15 g red pepper and 1200 mL water (Aksu et al., 2002). Approximately, 200 g of each muscle was taken using sterile knife from the end portion of muscles in the each sampling point. The muscle samples were separately shredded using a blender under sterile conditions and used in subsequent microbiological and physicochemical (moisture, pH and a_w) analyses.

2.2. Physicochemical analysis of pastirma samples

Pastirma samples were analyzed for their moisture content according to AOAC methods (AOAC, 2000). Pastirma samples were shattered and dried at 105 °C in an oven (Nuve, Ankara, Turkey) and the results were expressed as percent moisture. Water activity (a_w) was measured using a_w meter (Aqua Lab 2.0, USA). To determine pH values of the samples, 10 g of sample was weighed and blended in