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Researches on the Ripening of Turkish Fermented Sausage Using a Local Starter Culture Combination

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Abstract: This study is realized in the aim of investigate the starter culture use effect on the ripening of Turkish fermented sausage. The starter culture combination obtained from Turkish fermented sausage microflora included *Staphylococcus carnosus* and *Lactobacillus plantarum* strains. Organoleptic, physico-chemical and microbiological analyses were carried out on the Ist, 3rd, 6th, 9th, 12th and 15th days of ripening period. Results showed that best quality specifications for Turkish fermented sausage are obtained on 6th and 9th days of ripening period.

Key Words: Fermented sausage, ripening, maturation, starter culture

Yerli Bir Starter Kültür Kombinasyonu Kullanılarak Türk Fermente Sucuğunun Olgunlaştırılması Üzerine Araştırmalar

Özet : Bu çalışma, Türk fermente sucukları mikroflorasından elde edilmiş bir starter kültür kombinasyonunun, üretimde kullanılmasının sucukların olgunlaşması üzerine etkisinin araştırılması amacıyla yapıldı. Bu nedenle, Türk fermente sucuklarından izole ve identifiye edilmiş olan *Staphylococcus carnosus* ve *Lactobacillus plantarum* suşlarından oluşan karışım üretim esnasında sucuk hamuruna ekildi. Olgunlaşma süresinin 1., 3., 6., 9.,12., ve 15. günlerinde sucuklardan alınan numuneler organoleptik, fizikokimyasal ve mikrobiyolojik açıdan analiz edildi.Elde edilen bulguların değerlendirimesinde, Türk fermente sucuğuna özgü kalite özelliklerinin olgunlaşmanın 6. ve 9. günlerinde en iyi oluştuğu sonucuna varıldı.

Anahtar Sözcükler: Fermente sucuk, olgunlaşma, starter kültür.

Introduction

Turkish fermented sausage is a precious meat product made by adding determined levels of spices and other ingredients to the meat-fat mixture needing microbiological fermentation for ripening (maturation) (1,2). The desirable microflora is composed of non-pathogenic Gram negative hallophyllic bacilli, *Micrococcaceae,* yeasts and Gram positive bacilli which ripens, reduces ripening period then increase sausage quality (3,4,5,6,). In conventional fermented sausage technologies, development of the desirable flora is competely hazardous in very long production and natural ripening period (2,7). In modern technologies, ripening process is carefully controlled by introducing selected microbial strains and using climatized drying rooms (5,8,9), It is stated that, firstly Cesari tried microorganisms in meat products technologies. Then, in 1935, Jensen worked with *Lactobacillus plantarum, Lactobacillus brevis and Lactobacillus fermenti* strains in the aim of improving sausage quality (10-11). İnal (12) mentioned in his study that *Pediococcus cerevicea and Micrococcus aurenticus* cultures speed up ripenning and develop color and flavor in Turkish fermented sausages. In another study realized by Uğur (11), it is specified that sausages produced by using micrococcus cultures had standard quality and Turkish sausage properties. But use of micrococcus and Lactobacil strains together resulted with sour flavor. Some authors report that lactobacillus used alone as starter may cause damages in fermented sausage technology. They advise lactobacillus to be used together with micrococus. Because, the synergistic effect of these two organisms will result by desired color, flavor, texture and conservation specifications (4,10,11,13).

Microflora that gives its own special properties to Turkish fermented sausages, occurs and develops hazardously, depending on primary and secondary contaminations. This process affects quality negatively.Although Turkish fermented sausages are one of highly consumed meat products, few are works about quality development and standardization. This study aimed monitoring the effect of the use of a starter

culture combination obtained from turkish fermented sausages on the quality and ripenning of sausages.

Materials and Method

Samples from experimentally produced 2 parts of sausages are used. One of the parts, test group, was produced with starter culture while the other one served as control. Each part weight was 10 kg.

Starter culture was composed by *Lactobacillus plantarum* and *Staphylococcus carnosus* isolated and identified from Turkish fermented sausages and stocked in refrigerated rooms at TÜBİTAK-Gebze.

Process

Meat-fat mixture was prepared as usual, then spice and other additives were added and all were ground. The mixture was left at 2-4 ˚C for 1 day (1,2). The following day, it jas divided into two parts. First part (I) was inoculated with 10^7 microorganisms/gram starter culture combination including strains in 1:1 level (4,14,15). The second part (II) without starter served as control. Sausage mixtures were stuffed in 60 calibre casings and ripened in following conditions (2,6,7).

Analyses

Laboratory analyses were carried out on the Ist, 3rd, 6th, 9th, 12th and 15th days of ripening period. Organoleptic analyses were conducted by the modified method as described by Yıldırım (6). Menha electropH-meter and water activity apparel were respectively used for PH and Aw analyses (16,17). For microbiological analyses, samples were homagenized, diluted then tarnsferred on culture media. Total aerobic mesopillic bacteria, coliform, streptococcus, enterococcus, lactobacillus, mold and yeast counts were determined (4,18,19,20).

Results

PH and Aw values determined in the ripening period of both groups are given in Table 1. And their microbiological analyse results are given in Table 2. Figure 1. shows staphylococcus numbers while Figure 2. shows lactobacillus numbers in both groups. Organoleptic properties assessed during ripening period are given in Table 3.

Discussions

In our study, Aw levels of both groups decreased function of climatized conditions maintained during ripening period. Aw decrease were specially underlined on the 3rd day. Also, in this period, an accentuated decrease of pH is marked. pH decrease reached its maximum in the inoculated group on the 6th day, in control group on the 9th day (Table 1).

Table 1. pH and Aw during ripening period in test (I) and control (II) groups

Physico-chemical property	Part No	Ist day	3rd day	6th day	9th day	12th day	15th day
pH	I	5.80	5.10	4.88	4.95	5.15	5.29
	II	5.98	5.46	5.20	5.14	5.20	5.25
Aw	I	0.95	0.87	0.82	0.79	0.77	0.75
	II	0.96	0.89	0.84	0.82	0.80	0.78

Total aerobic organisms count of both groups declined in accordance with pH and Aw decrease till 6th and 9th days of ripening. But on the 12th and 15th days, this number sensibly increased because of mold and yeast development. By the end of ripening period, molds and yeasts may grow up on sausage surface function of low temperature-high humidity and may cause quality loss (4,6). Similarly total aerobic

	Ist day	2nd day	3rd day	4th day	5th day	6th day	7th day	9th day	12th day	15th day
Temperature (˚C)	25	24	22	20	18	16	14	12	12	10
Humidity (%)	95	90	85	80	75	75	75	70	70	70
Air speed (m/sec)	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0	1.5-2.0

organisms, streptococcus, enterococcus and coliform counts declined specially in inoculated samples (Table 2). Many authors stated that micrococci and lactobacilli used as starter shows an antagonist effect on undesired microorganisms (5,9,21).

Table 2. Microbiological counts during ripening period in test (I) and control (II) groups (cfu/gr)

Microorganism	Part No	Ist day	3rd day	6th day	9th day	12th day	15th day
Total aerobic mesophyllics	I	$2,5.10^7$	$1,6.10^7$	$6,0.10^6$	$3,0.10^6$	$4,0.10^6$	$7,0.10^6$
	II	$3,0.10^6$	$5,0.10^6$	$1,0.10^6$	$6,0.10^6$	$3,0.10^6$	$5,0.10^6$
Coli forms	I	$3,5.10^5$	$4,0.10^5$	$5,0.10^2$	$7,0.10^2$	$1,5.10^3$	$6,010^2$
	II	$2,0.10^5$	$1,0.10^5$	$6,0.10^4$	$3,4.10^4$	$2,2.10^4$	$3,0.10^3$
Strepto-coccus	I	$2,0.10^6$	$3,2.10^5$	$1,2.10^5$	$1,2.10^4$	$1,6.10^3$	$1,2.10^3$
	II	$3,0.10^4$	$2,3.10^4$	$5,0.10^3$	$3,4.10^3$	$2,0.10^3$	$1,5.10^3$
Staphylo coccus	I	$1,6.10^7$	$9,0.10^6$	$8,2.10^5$	$6,1.10^4$	$2,3.10^4$	$4,3.10^3$
	II	$2,4.10^6$	$1,3.10^6$	$2,1.10^6$	$4,5.10^4$	$3,6.10^4$	$2,4.10^4$
Entero coccus	I	$2,0.10^6$	$1,1.10^6$	$5,5.10^4$	$3,2.10^3$	$4,3.10^4$	$4,6.10^4$
	II	$3,0.10^5$	$1,4.10^5$	$1,2.10^5$	$3,2.10^4$	$2,1.10^4$	7,0.103
Lacto-bacillus	I	$4,7.10^6$	$5,2.10^6$	$4,2.10^6$	$5,3.10^6$	$5,7.10^6$	$6,6.10^6$
	II	$2,1.10^4$	$6,2.10^4$	$4,3.10^5$	$5,2.10^5$	$7,5.10^5$	$1,3.10^6$
Yeast and Moulds	I	$3,8.10^3$	$6,2.10^3$	$1,5.10^4$	$1,8.10^4$	$3,2.10^4$	$4,2.10^4$
	II	$5,0.10^3$	$2,4.10^3$	$4,6.10^2$	$2,7.10^3$	$3,6.10^3$	$1,2.10^4$

In the beginning of ripening period, micrococci lower pH, so gram positive bacilli may reproduce, grow and dominate the microflora (5,7). Thus, in this study elevated staphylococcus numbers of first days decreased rapidly by the 6th day of ripening period in all groups (Figure 1). Lactobacillus counts were high in the Ist day in test group because of inoculation leel and then they dominated microflora. But in control group this count was low at the beginning, reached its maximum on the 6th day, then dominated the microflora (Figure 2).

Nitrate reducing organisms have very important role in desired red color development and stabilization of fermented sausages (21,22,23,24). Therefore, in inoculated samples, brown-red color function of high temperature at the beginning of ripening period, took its special red color on the 3rd and 6th days and stabilized in non-inoculated samples, color development began on the 9th day and stabilized after the 15 day (Table 3).

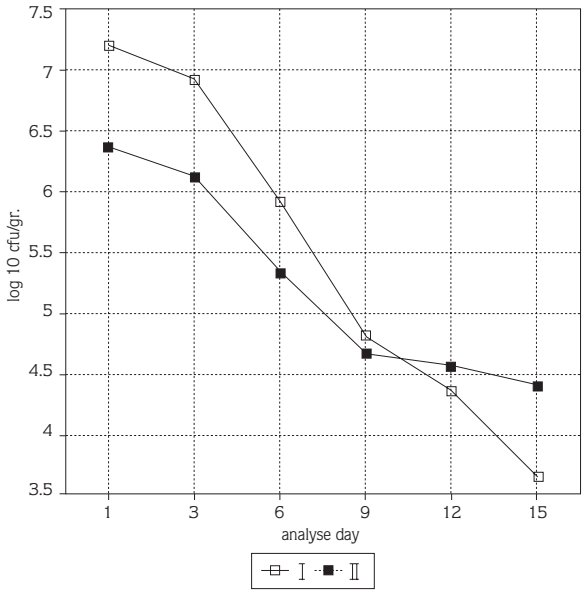
Table 3. Organoleptic properties assessed in ripening period of inoculated (I) and non inoculated (II) fermented sausages

Property	Part No	Ist day	3rd day	6th day	9th day	12th day	15th d
Shape	I	6,44	7,55	8,33	8,00	7,88	7,88
	II	6,22	6,77	7,00	7,33	7,88	8,00
Color	I	6,55	7,77	8,33	8,44	8,55	8,66
	II	5,55	6,11	6,44	7,22	7,44	7,88
Fat dispertion	I	6,22	6,55	7,44	7,66	7,55	7,55
	II	6,11	6,22	7,11	7,33	7,33	7,33
Texture	I	5,33	6,66	8,22	8,33	8,33	8,22
	II	5,00	5,44	6,11	7,22	8,44	8,33
Odor	I	6,22	6,66	7,44	7,66	7,88	8,00
	II	6,22	6,33	6,66	6,88	6,88	7,11
Flavor	I	6.33	6.55	7.77	8.00	8.11	8.22
	II	6.11	6.33	6.55	6.77	7.44	8.00

In fermented sausages, soft texture becomes drier and particular because of pH lowered by lactobacilli (11). Therefore, in our study the minimal pH level of inoculated samples is assessed on the 6th and 9th days where lactobacilli dominated the microflora and suitable texture occurred. In non-inoculated samples the same phenomenon happened on the 9th and 12th days (Tables 1, 3, figure 2).

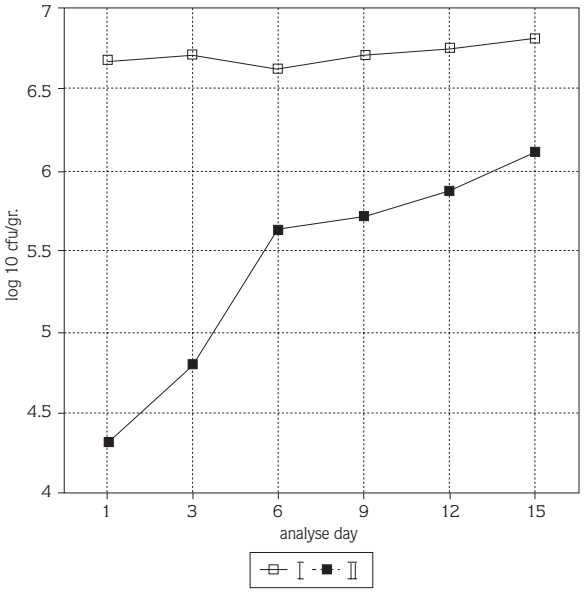
Best quality specifications were detected on the 6th and 9th days of ripening for inoculated sausage samples. Specially on the 6th day, organoleptic results were very approached of Turkish fermented sausages' (tables 2,3). In this period lactobacilli were dominant and micrococci were pasified. Thus, pH was very low and specific color, texture, odor and flavor were assessed. In non-inoculated samples the said phenomenon was delayed and results were not enough successful (Tables 1,3).

The aim of starter culture use is being able to catch and standardize products made by natural fermentation, suitable to local habits and preference for each country. Cultures added to sausage mix, grow up together with the beginning flora. That is why, producers have to take hygiene care and proceed with safe raw materials if they would control fermentation. Only these conditions may allow production of qualified and standard Turkish fermented sausages within one week, a very short period. Starter cultures used in this study are isolated and identified from Turkish fermented sausages and they are representing production and personal hygiene of our country. For this reason, this study is specially important to compare foreing starters with local starters and to underline



I. Fermented sausage with starter culture
II. Fermented sausage without starter culture

Figure 1. Staphylococcus numbers of inoculated (I) and non-inoculated (II) fermented sausages.



I. Fermented sausage with starter culture
II. Fermented sausage without starter culture

Figure 2. Lactobacillus numbers of inculated (I) and non-inoculated (II) fermented sausages.

that Turkish fermented sausage quality characteristics must be kept. Some authors report that Lactobicillus used alone as starter may cause damages in fermented sausage technology.They advise lactobacillus to be used together with micrococcus. Because, the synergistic effect of these two organisms will result by desired color, flavor, texture and conservation specifications (4,10,11).

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