The Effect of Commercial Starter Cultures and Three Carbohydrate Types on Some Properties of Turkish Sucuk

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SUMMARY: The effects on Turkish sucuk by the usage of three different carbohydrate types and different levels of starter cultures were examined in this study. The sucuk combinations consisted of 80% lean meat, 20% catle fat and of spices. It has been observed that carbohydrates affected the pH decline rates after fermentation, moisture contents during fermentation and drying, caused the aw and TBA values to decrease and the maturing periods to shorten. The usage of starter cultures resulted a controlled fermentation. The best sucuk combination is found to be the one containing glucose with the starter cultures.

INTRODUCTION: In Turkey sucuk is considered to be a typical fermented meat product. Sucuk is made by ground beef meat mixed with spices and curing ingredients. It is filled in natural or artificial casing. After the filling process fermentation and then drying is applied.

Fermentation is a very important step in the production of these kind of products. According to the traditional production of sucuk the fermentation is continued by using homofermentative lactic acid bacteria which is inoculated by adding ripened sucuk in the meat mixture. If the right organism are present in the mixture the flavor, color, texture and aroma of the sucuk will be ideal. If the wrong organisms gain control, the sucuk will be completely unappetizing and inedible, or may actually burst in the process (Everson et al.,1970). Adding lactic acid bacteria as starter culture to 10^7 - 10^9 /g meat mixture may prevent the growth of undesirable microorganisms (Nordal and Slinde 1980). Producing sucuk by using back-sloping technique is a primitive method which leads to economic loss. Using starter culture results in a controllable fermentation and drying which in return minimizes the production defects.

This study was done to evaluate the effects of using starter culture and fermentable carbohydrates on sucuk quality.

MATERIALS and METHODS: The beef used in this research was dissected from excess fat and connective tissues. Boneless beef was ground twice through 3 mm plate. It was porsioned into mixtures of 1kg each containing 80% lean meat and 20% beef fat in polyethylene bags. Bags were stored for 7 days at 23°C until they were used. The meat mixtures were thawed for 24 hours at 4°C. The starter culture used in this study was the CHR Hansen's lyophilized Starter Culture preparate which contains Lactostart 03 and Pediostart 40. Powdered stater cultures were diluted in 1 ml sterile distilled water and inoculated in the meat mixture. 2% each of these different types of carbohydrates, glucose, sucrose and lactose were used also in the sucuk mixture. Red pepper, black pepper, cumin, allspice and in addition to these 200 ppm nitrite, 3% salt were used in the sucuk.

In this study three different levels of starter culture and three different types of carbohydrates were experimented. The amounts of starter culture per kg of sucuk mixture are S1:0.4 g, S2:0.5 g, S3:0.6 g and SO:control (without any cultures). Each of these batches were also divided into four subgroups and they were addedrespectively 2% glucose, 2% sucrose and 2% lactose. No carbohydrates were added to the control sample. By using different levels of starter cultures and varios types of carbohydrates 16 different sucuk batches were handed. Each sucuk preparation was stuffed into 30 mm diameter fibrous casing. Sucuk chunks each measuring approxi= matelly 25 cm were hung in a cold room at 4°C and were held for 12 hours for the improvement lactic flora. They were then hung in a conditioning cabin at 35°C (RH 80%-85%) for 42 hours. At last, they are transferred to the drying chamber, where they are kept at 18°C and RH 60%, until the 11th day. During the fermentation lactic acid and pH was measured each 3 hours.During the drying period lactic acid, pH and moisture content were measured in each day. The procedures of Acton et al.(1972) were used to obtain sucuk pH and acidity(lactic acid equivalent). Total acidity was calculated as lactic acid. The moisture content was determined according to AOAC (1975).Water activity and TBA (Thiobarbituric acid) values were measured in the initial sucuk mix and final product. Water activity was measured using a water activitymeter (NovaSina model) and measurements were recorded after the samples were held for 2 hours at 20°C in the jars. The TBA values were determined by the methods of Tarladgis et al.(1960). Analysis of samples were duplicated for each sample. The whole experiment was repeated three times. The data was analysed by the standart statistical variance analysis techniques which was described by Steel and Torrie (1960).

RESULTS and DISCUSSION: The average pH measurements of 16 different sucuk samples during the fermentation period are shown in Table 1. Starter culture levels and carbohydrate types affected the pH values significantly during the whole fermentation($P < 0.1$).

Table 1.Effect of different starter culture levels and different carbohydrate types on mean pH value during fermentation.(n=16)

Sugar / Starter culture	Control	Lactose	Sucrose	Glucose	mean
So	5.85	5.56	5.50	5.58	5.62
S1	5.88	5.62	5.52	5.47	5.62
S2	5.79	5.60	5.53	5.32	5.56
S3	5.91	5.58	5.46	5.30	5.56
Mean	5.86	5.59	5.50	5.42	5.59

Control sucuk samples which were not added carbohydrate had the lowest pH values at each type of starter culture. The pH values for sucuk samples are ranging from 5.91 to 5.30 during the fermentation. Samples prepared with lactose had higher pH values than the one with glucose or sucrose. Ph values decreased with increasing amounts of starter culture in the samples which were prepared with 2% glucose. In all the samples which were not added starter culture but prepared with glucose the average pH was found to be 5.5 while with incresing amounts of starter culture average pH values were 5.47, 5.30, 5.30.

During the fermentation period the pH values of all the samples without any carbohydrate were not below 5.79 for different starter culture levels. The manufacture of fermented sausage is dependent on the proper activity of lactic acid bacteria. The rapid production of lactic acid from fermentable carbohydrates results with a drop in pH (Romeo and Mckay,1985; Brown,1980; Bacus and Brown,1981). In this research too, starter cultures have not any activity in the samples which had no carbohydrate and the average pH was found high. Similarly, Deketeleare et al.(1974), following their researh, have found that addition of fermentable carbohydrates of 1% to the fermented products caused 1 unit drop in pH. Also, during fermentation, for all the starter culture levels pH values at all the samples prepared with glucose were found low compared with the ones added lactose or sucrose (Table 1). Starter cultures added to the samples have been more effective in degrading glucose than they are in degrading the other carbohydrates. In addition to this, it has been determined that their degradation of lactose being a source of carbohydrate, is limited. On the research carried out by Acton et al.(1977), it has been shown that, the use of glucose, sucrose, maltose, lactose and dextrin at a level of 1% in the fermented products did not cause the pH drop considerably during the first six hours following the fermentation at 38°C and the pH level for the glucose or sucrose added samples was lower than the ones which were added other carbohydrates. At all levels of starter culture, samples with the addition of glucose had considerable pH drops. A number of researchers have emphasized the certainly of using canbohydrates such as glucose, sucrose, corn syrup to reach fermentation in all meat products fermented with a starter culture or natural flora fermentation.

During the fermentation period lactic acid measuremunts of sucuk samples were recorded every three hour. Table 2 presents the data obtained as percentage lactic acid values of 16 different sucuk samples during the fermentation perion. Starter culture levels and carbohydrate types affected the lactic acid values significantly during the whole fermentation ($p < 0.01$). In the control samples which were not added any carbohydrate the average lactic acid percentage recorded lowest at each three starter culture levels. Samples prepared with lactose had the lowest lactic acid percentage values compared with glucose and sucrose at each three starter culture levels. On the other hand samples prepared with glucose had shown the highest percentage of lactic acid values. In the sucuk samples with no starter culture but prepared with glucose, the lactic acid value was registered as 0.77% however in the sucuk samples with S1, S2, S3 starter culture levels, the values were respectively 0.94%, 1.13%, 1.16%.

Table 2. Effect of different starter culture levels and different carbohydrate types on mean % lactic acid value during fermentation.

Sugar / Starter culture	Control	Lactose	Sucrose	Glucose	Mean
So	0.48	0.83	0.82	0.77	0.73
S1	0.40	0.72	0.87	0.94	0.73
S2	0.34	0.76	0.92	1.13	0.79
S3	0.34	0.78	0.98	1.16	0.82
Mean	0.39	0.77	0.90	1.00	0.77

Lactic acid bacteria used as a starter culture in the sucuk mixture fermented the carbohydrates which were added to the formulation and produced lactic acid. Lactic acid caused the pH to drop in the samples during the fermentation. Relation between pH and lactic acid content in this study was similar to the studies of sausage fermentation reported in other researches (Deketelaere et al.,1974; Acton et al.,1977; Brown,1980).

During the fermentation and drying period pH measurements of sucuk samples were recorded in 24 hours intervals. Average pH values are shown in Table 3. There was a significant affect of using carbohydrates and various starter culture levels on pH decrease ($P < 0.01$). Acid production was enchanced in the sucuk containing glucose and S3 level starter culture, the average pH was recorded as 4.99.

Table 3. Effect of different starter culture levels and different carbohydrate types on mean pH value during fermentation and drying.

Sugar / Starter culture	Control	Lactose	Sucrose	Glucose	Mean
So	5.89	5.34	5.22	5.31	5.44
S1	5.89	5.37	5.08	5.04	5.35
S2	5.93	5.38	5.07	5.03	5.35
S3	5.99	5.35	5.04	4.99	5.34
Mean	5.93	5.36	5.10	5.09	5.37

Table 4. Effect of different starter culture levels and different carbohydrate types on mean percentage of lactic acid value during fermentation and drying.

Sugar / Starter culture	Control	Lactose	Sucrose	Glucose	Mean
So	0.39	1.13	1.33	1.15	1.00
S1	0.40	1.07	1.45	1.51	1.11
S2	0.32	1.05	1.48	1.53	1.09
S3	0.24	1.13	1.50	1.55	1.10
Mean	0.34	1.09	1.44	1.43	1.08

In the samples with no starter culture added but prepared with different carbohydrates, average pH did not drop below 5.22 during fermentation and drying periods (Table 3). When starter cultures were used, increased amounts of them were able to enchance the pH drop at this period. In the sucuks which were added lactose, the average pH was recorded higher than the samples containing glucose and sucrose inspite of adding starter cultures.Sucrose resulted a drop in pH but it was not effective as glucose. These results suggest that the effective drop in pH both in presence and absence of starter culture was due to the carbohydrate type. Starter cultures consumed more glucose and sucrose than lactose. These results have been previously reported also by Acton et al.(1977).

Table 4 shows the average percentage of lactic acid content of sucuk samples during fermentation and drying. Starter culture levels and carbohydrate types were found effective on average percentage of lactic acid amounts ($P < 0.01$). The control group which were not added carbohydrates have given low percentage of lactic acid. On the other hand in the samples prepared with carbohydrates percentage of lactic acid were recorded higher than the control groups at each starter culture level. The samples prepared with glucose gave the highest

lactic acid percentage values at all starter culture levels. Increased levels of starter culture, yielded increased percentage of lactic acid content when the glucose was added as a carbohydrate. In the samples which contain S3 level of starter culture and were added 2% glucose, lactic acid percentage was found to be 1.55. Lactic acid value in the fermented products depends on the additives such as salt, carbohydrates and species (Deketelaere et al.,1974). Table 5 shows the average moisture content percentage during fermentation and drying.

Table 5. Effect of different starter culture levels and different carbohydrate types on mean percentage of moisture content during fermentation and drying.

Sugar / Starter culture	Control	Lactose	Sucrose	Glucose	Mean
So	51.90	49.87	50.77	49.97	50.63
S1	52.94	49.89	50.22	51.11	5103
S2	53.59	52.13	50.64	50.68	51.76
S3	52.83	48.61	49.70	48.71	49.62
Mean	52.82	50.12	50.33	50.11	50.84

Table 6. Effect of different starter culture levelsand different carbohydrate types on aw value, after stuffing (a) and after drying (b).

Sugar / Starter culture		Control	Lactose	Sucrose	Glucose
So	(a)	0.963	0.973	0.967	0.967
	(b)	0.910	0.893	0.893	0.893
S1	(a)	0.977	0.983	0.970	0.963
	(b)	0.927	0.912	0.893	0.883
S2	(a)	0.967	0.963	0.967	0.967
	(b)	0.903	0.893	0.897	0.863
S3	(a)	0.967	0.967	0.967	0.960
	(b)	0.933	0.893	0.877	0.867

Table 7. Effect of different starter culture levels and different carbohydrate types on TBA value after stuffing (a) and after drying (b).

Sugar / Starter culture		Control	Lactose	Sucrose	Glucose
So	(a)	0.37	0.39	0.26	0.39
	(b)	3.92	3.22	3.26	2.93
S1	(a)	0.34	0.37	0.26	0.56
	(b)	4.06	3.98	3.64	3.35
S2	(a)	0.26	0.31	0.31	0.39
	(b)	3.80	3.25	3.12	2.91
S3	(a)	0.39	0.40	0.26	0.37
	(b)	3.33	3.14	3.14	2.93

All samples with carbohydrate types gave more succesful results than the control groups. Also the starter culture levels affected the moisture contents of the samples ($P < 0.01$). In the samples with S3 starter culture level and glucose, the lovest moisture content, 48.71% was determined. Similar results were recorded by Panareas and Boulkas (1984). They found that fermented sausages which were added starter cultures show shorter drying periods than the control samples. An effectiv drop of pH caused decreased moisture content.

The aw values before fermentation and after drying are given in the table 6. The aw values ranged between 0.960-0.983 in the sucuk samples after stuffing. After drying the values were recorded between 0.933-0.863 (Table 6). Effects of starter culture level and fermentation temperature on aw were found significant ($P < 0.01$). The combined effects of starter culture level and carbohydrate type on aw probably is a result of protein denaturation. An effective drop of pH caused and accelarated the removal of moisture from the sucuk samples and resulted in a lower aw. Similar results were recorded by Childers et al.(1982), the rapid drop of pH related to the starter culture usage, caused a protein denaturation. This situation accelerated drying and the aw rapidly decreased.

TBA values of sucuk samples before fermentation, after stuffing, and after drying are seen in the table 7. After stuffing the TBA values ranged between 0.26-0.56 mg malonaldehyde/kg. These values recorded an increase due to the lipit oxidation during fermentation and drying. At each three starter culture levels the lowest TBA value were found in the samples which were prepared with glucose. Starter culture levels and carbohydrate types were found effective on TBA values ($P < 0.01$). The results indicated that combined effects of effective drying and declining pH probably results lower TBA values. Many of the researchers had suggested that, some physical and chemical parameters of raw meat could effect the TBA value of the products (Farr and May,1970; Townsend,1980).

CONCLUSIONS: The work presented here was done to determine effects of starter culture levels and carbohydrate types on sucuk. It is demonstrated that carbohydrate types affected the sucuk properties. Addition of starter cultures allowed an effective drop in pH. Lactic starter cultures consumed more glucose and produce more lactic acid than sucrose and lactose. Using 0.6 g/kg Pediococcus cerevisia and Lactobacillus plantarum commercial starter cultures and 2% glucose as a carbohydrate type, could obstruct production failures.

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