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Influence of Environmental RH on Some Physical and Chemical Properties of Turkish Sucuk

S.O.TÖMEK and A.BULGAY
Ege University, Engineering Faculty, Food Engineering Department, Bornova, İzmir, Turkey

SUMMARY: The effect of relative humidity (RH) on the physical, chemical and sensory properties of Turkish Sucuk was investigated during fermentation and drying period. For this object the relative humidities were selected for three different experiment groups as 85%, 75% and 65%. Air velocity and temperature of fermentation and drying were constant for all these different RH groups. In three experimental groups pH, total acidity, weight loss and penetrometer values were determined with 6 and water activity (aw) was determined with 12 hours intervals. The thiobarbituric acid (TBA) values were determined at the beginning and at the end. Sensory properties of the products were also evaluated. The results of the chemical,physical and sensory evaluations indicated that the most appropriate RH during fermentation and drying was 85%. In this group, pH decline, increase of total acidity, weight loss and hardness developed faster than the other groups and lower water activity values were obtained.

INTRODUCTION: The traditional Turkish meat product Sucuk has a granule structure and a very specific aroma. These characteristics are obtained by fermentation and drying without cooking (Turgut,1977; Alperden et al.,1981). Fermentation and drying are the most important steps in sucuk production, as sucuk gain the specific taste, smell and texture during these steps (Yıldırım,1977; Alperden et al.,1981; Göğüş,1986; Tömek and Serdaroğlu,1990). Low moisture content, low aw and pH value give long shelf-life to sucuk without cold storage necessity. These properties are obtained by physical and chemical changes which occur during ripening (Gökalp,1984; Tömek and Serdaroğlu,1990).

The ripening of sucuk takes place under natural conditions in Turkey so a controlled atmospheric requirements can't be provided by most of the manufacturers. Therefore, weight loss and pH falling rate can't be controlled so low quality products are produced. The natural conditions also do not permit to use the capacity efficiently (Ertaş and Göğüş, 1980). An effective and efficient production is possible under controlled atmosphere which can be adjusted to the desired conditions. According to Rödel and Stiebing (1989), there must be several methods in the ripening of fermented sausages and the best quality products are obtained by the continuous control of the parameters such as weight loss, pH and aw in the process. A lot of factors are effective on ripening periods of fermented and dried meat products. They can be classified as internal and external factors. The internal factors are; salt content (Petaja et al.,1985), sugar content (Acton et al.,1977), sugar type (Pyrcz and Pezacki,1974), fat content (Rödel and Stiebing,1989), meat particle size (Keller et al.,1974), pH of meat (Townsend et al.,1975), casing type (Rödel and Stiebing,1989) and casing size (Keller et al.,1974; Stiebing and Rödel,1988).

The external factors are; environmental temperature (Acton et al.,1977), relative humidity (Stiebing and Rödel, 1988), air velocity (Townsend et al.,1975; Rödel and stiebing,1989) and hanging position (Townsend and Davis, 1972). Stiebing and Rödel(1988) ripened the meat products in three different levels of RH. It has been determined that drying rate decreases with increasing RH and aw values are related to the rate of drying. The metabolic activity of lactobasilli is influenced by the aw value and consequently the pH decline rate is affected. The effect of RH as an important parameter, on the physical and chemical properties of sucuk was researched in this study.

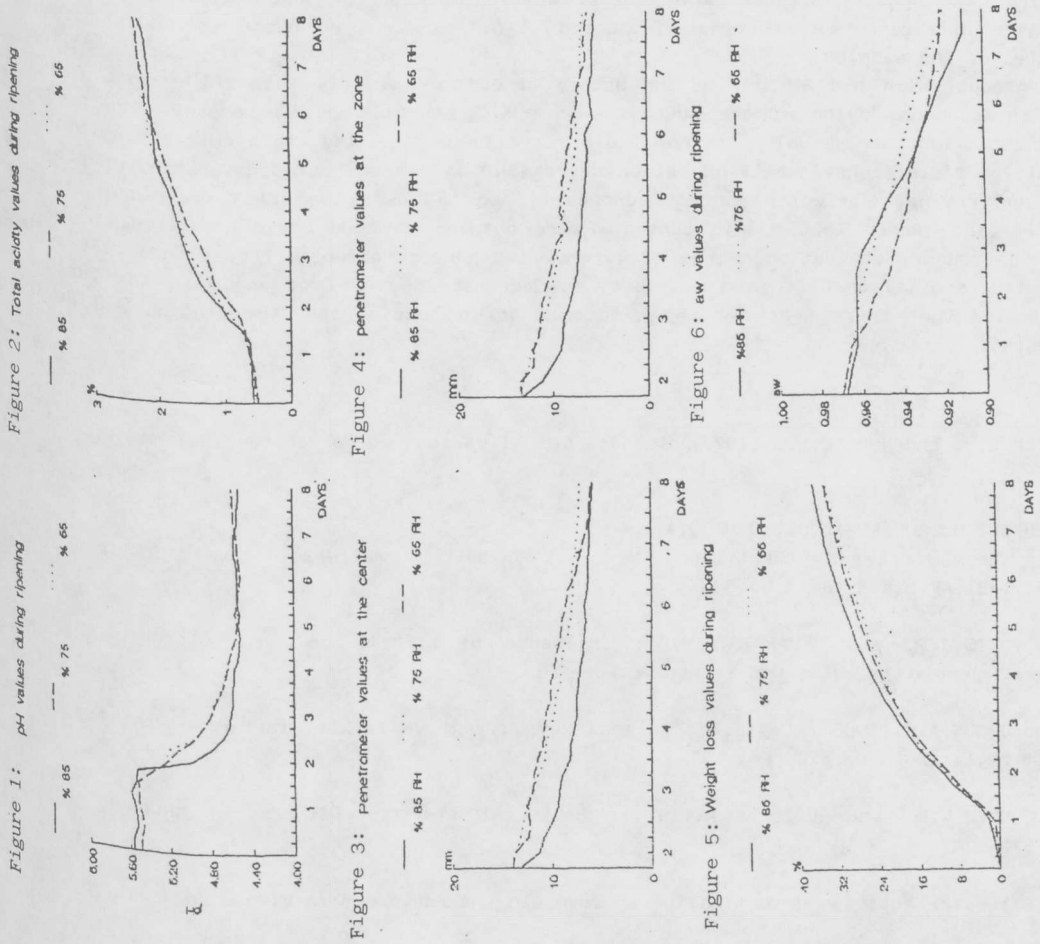
MATERIALS and METHODS: Sucuk was produced by using cow meat which was stored at -24°C for several days after dessecting the fat and the connective tissues. Formulation of the sucuk mix was; meat 77%, fat 15.4%, garlic 7.7%, black pepper 4.5%, cumin 1.4%,red pepper 0.4%, allspice 0.5%, sucrose 1.5%, ascorbic acid 0.5%, salt(NaCl) 2% and nitrite 0.0108%. For the preparation of sucuk mix, 10 kg of meat was thawed at 4°C. Then, it was ground through 4 mm plate with garlic and fat. Spices and curing ingredients were added to the mixture in cutter and mixed for four revolutions. Temperature of the mix was kept between 0-5°C during the preparation. After that, sucuk mix was stuffed into the 45 mm diameter, 170 mm lenght collagen (Naturin) casing and hanged in the room at 4°C and 90% RH. After this stage, the sucuk chunks were hanged from one end in a vertical position parallel to the flowrate of air in a ripening room. The experimental group consisted of 48 chunks. During the ripening period, the factors affecting the fermentation and drying like meat particle size, number of revolutions in cutter, temperature of the sucuk mix, formulation, casing size and type, temperature of the ripening room and air velocity were kept constant. Three different RH level groups 85% (first group), 75% (second group) and 65% (third group), were experimented. The ripening was carried out in Demaco 25 type Laboratory Drier in which the RH is adjustable. İn the first 24 hours of ripening, RH of the drier was 90%. Then drier was adjusted to the desired RH level. During the ripening period at 30°C, air velocity was 2 m/sec. for 3 hours and was stagnant (0 m/sec.) after this 3 hours. Ripening was finished when the sucuk reached the water content of 40%. To get homogenity, the position of sucuk were changed in every six hours. In every 6 hours from the beginning to the end of ripening, 3 sucuk samples were randomly taken and weight loss, pH, total acidity and penetrometer values were measured. Water activity was controlled with 12 hour intervals and TBA values were measured at the beginning and at the end. Sensory properties of the products were also evaluated. In order to calculate weight loss, the sucuk samples were weighted and percent losses were recorded. The pH was measured with the Keller and Acton (1974) method by using Nel-Digital pH-meter and the diluted sample mix prepared for the pH measurement, was titrated with 0.1 N NaOH solution until the pH reached to 7. The equivalent weight of the used volume of solution for 100 g. sample was expressed as a lactic acid percentage (Palumbo et al.,1976). The penetrometer values were determined with SUR- penetrometer in the center and in the zone between center and edge of the sucuk slices that had a thickness of 15 mm. Total weight of the penetrometer cone was 150 g.and the reading time was 5 sec.

after the cone fell into the sample. The aw determination was done on the basis of Fett (1973) method. For this, the dried sodium caseinate was equilibrated with the standard salt solution in hermetic jars and the moisture absorbtion was calculated. Then the standard absorbtion graphic was drawn. After this, sucuk samples were put in hermetic jars and their moisture absorbtions were calculated. The aw values were determined from the standard graphics. TBA values were determined according to the method of Tarladgis et al.(1960). In sensory evaluations, five panels evaluated the cooked and uncooked semples and graded them between the range 1-5. All the experiments were repeated for three times and the results were evaluated statistically.

RESULTS and DISCUSSION: During the ripening period, different pH values were obtained between experimental groups (Figure 1). These differences are significant between the first and the other groups. Also, in each group, changing of pH values with time is significant statistically ($P < 0.01$). The values at the beginning of the ripening were determined between 5.57 and 5.50 in the groups. During the waiting period at 4°C, there was no change in pH but in the ripening period between the first and the fifth day, pH falling rates were greater in the first group than the others (Figure 1). However at the end of ripening, the pH values in the groups reached to approximately 4.53, 4.58 and 4.59 respectively. The high pH falling rates in the first group can be explained by the aw values of the samples. The aw values of the first group did not fall almost until the 12th hour of the second day, but there were falls in the other groups. Lactobacilli can grow well in anaerobic conditions but lover aw value limits the growing rate (Lucke, 1985; Heperkan and Sözen, 1986; Stiebing and Rödel, 1988). So, Lactobacilli grew well in the first group and pH values fell rapidly. Debevere et al.(1975) observed similar pH changes. They indicated that, the number of Lactobacilli increased rapidly in the first three days and so pH falling rate also increased. then, the number became constant and so did pH.

The changes in total acidity were different between experimental groups. Truly, these differences were statistically important in the period between the eighteenth hours of the second and the third day. In the external time, the differences were not important (Figure 2). This situation is parallel with the results of the pH analysis. At the beginning, lactic acid ratios were 0.6%, 0.5% and 0.6% respectively in the groups and they increased continuously during the ripening period and reached to 2.3%, 2.4% and 2.4% in the groups one, two and three respectively. The change in the total acidity was parallel to the pH and aw changes. In the first group, during the first three days, when aw values remain unchanged, lactic acid concentrations increased rapidly. Later on, this increase slowed down when aw values decreased.

It had been observed that, the effect of RH on the aw value and the change of these values with time was significant ($P < 0.01$). Average aw values of the groups were 0.968, 0.971 and 0.970 respectively at the beginning. These values decreased to 0.963, 0.966 and 0.966 in the first day of the drying (Figure 6). Lucke (1985) indicated that initial aw value of the product which was created by the usage of 2.4-3% NaCl, was between 0.97-0.96, as it has been observed in this study. At the end of the ripening period, aw values were 0.915, 0.923 and 0.972



respectively and the lowest aw values were observed in the first group. In the third group, as a result of overdrying of the edges rapid decreases in aw values were observed at the beginning. As hard surfaces were formed around the samples, the centers could not be dried and decreases in aw values slowed down. In the second group, the overdrying of the edges and the decreasing of aw values also took place following a parallel path with the third group, but because the RH were higher, the aw values were also higher than the third group. Stiebing and Rödel (1988) noted that, during the drying stage of the fermented meat products, there is a migration of salt from the edge to the center. The rapid decrease of aw in the second and third groups at the beginning can be explained by the rapid drying of the edges and increasing of the salt concentrations in the centers and consequently by the decreasing of usable water contents. If the drying rates of the edges increase, the salt contents increase relatively and because of the salt content differences between the centers and the edges, salt migration speeds also increase.

During the ripening period, the second and third groups got approximately the same weight loss values, but the first group lost more weight than the other two groups (Figure 5). This difference was statistically significant ($P<0.01$). At the end of the ripening period observed weight losses were 37.1%, 34.7% and 34.9%, respectively. Overdrying of the edges prevented the weight losses in the centers of the second and third groups, so the first group which was dried homogenously at 85% RH lost more weight. This situation was also noted by Townsend and Davis (1972), Keller et al.(1974) and Yıldırım (1977).

Figures 3 and 4 indicate the effect of RH on the penetrometer values which were measured in the centers and in the zones between the centers and the edges, and the decrease of the values with time were significant ($P<0.01$). It was observed that, initial values of the groups were respectively 13.2, 14.0 and 14.0 mm for the centers and 13.3, 13.6 and 13.3 mm for the zones between the centers and the edges. There was a continuous decrease in the penetrometer values during the ripening period. In the second day, the first group showed the greatest differences compared to the other groups. But these differences decreased toward the end of the period and became insignificant statistically. At the end of the period, penetrometer values were 5.9, 7.1 and 6.1 mm for the centers and 5.5, 6.8 and 6.3 mm for the zones between the centers and the edges of the groups respectively.

During the ripening period, changes in the TBA values were not important. TBA values in the first, second and the third groups were 0.56, 0.58 and 0.60 at the beginning and 0.69, 0.70 and 0.72 at the end respectively.

Sensory evaluation in uncooked samples showed that, the effect of RH on the colour, odour and cutting surface properties of sucuk were not important statistically. In cooked samples, the effects of RH on the colour, odour, cutting surface and texture properties of sucuk also were not important but its effects on the taste and general acceptance characteristics were changed significantly. First group got higher scores while the third group got lower scores than the other groups. Serdaroğlu (1987) noted that higher concentration of lactic acid can cause undesirable changes in taste. So the samples with high lactic acid concentration resulted with low scores.

CONCLUSIONS: The results of the study indicated that the RH of environmental atmosphere of the drier, affects the physical, chemical and sensory properties of sucuk. While the final pH and lactic acid values were not affected by RH, their difference rates were affectected significantly. The cause of these differences are different drying rates of the samples.

In this study, the groups which had 85% RH in the drier, dried more rapidly than the others. This is caused by the regular and homogenous drying of the sucuk chunks and by the homogenous removal of moisture content. As a result of this situation, the aw value stayed stable for a certain period. This suitable aw value permitted the growing of lactic bacteria, consequently pH values decreased. As a result of denaturation of proteins caused by the pH decline and drying, the water contents decreased, so the aw values also decreased. In the study, overdropped pH values and excess lactic acid contents were obtained by the usage of 2% sugar. The excessive pH dropping caused the sensory evaluation scores of flavour and general acceptability to drop. Relying on these results, it had been determined that it is a necessity to decrease the level of sugar in the further studies. Low TBA values indicated that there were not any oxidation of fat during the fermentation and drying periods in all the experimental groups.

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