# USE OF HEN MEAT AND DIFFERENT NITRITE LEVELS IN A FERMENTED MEAT PRODUCT-SUCUK

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## INTRODUCTION

Sucuk is a popular and traditional fermented meat product in Turkey. Beef or mixtures of beef and lamb is generally used in sucuk producing. On the other hand, the utilisation of mature hen, used for egg production is a problem in poultry industry. Annually 300 000 ton hen meat is produced. Therefore use of hen meat in meat products industry is important in Turkey.

In this research using hen meat instead of beef was investigated while Turkish Sucuks special color, flavor and texture were tried to be preserved.

The effects of nitrite on color and flavor development, and also as an antimicrobial and antioxidant agent in meat products are well known.

Some researchers showed that those effects are more pronounced when the concentration of nitrite is increased (Sofos et al.,1979; Wesley et al., 1982).

Some others are against this opinion and found that the nitrite concentration was not very important (Hustad et al.,1973; Brown et al.,1974; Sales et al.,1977; Sebranek, 1979; Dryden and Birdsall,1980; Marrict et al.,1981; Wesley et al.,1982).

In this study the determination of suitable percentages of hen meat in the sucuk mix and also the most efficient nitrite level were carried out.

## MATERIALS AND METHODS

Beef and hen meat were used in the experiments. The hen carcasses were obtained from the slaughter house of the Agriculture Faculty. All the hen carcasses were frozen at 18 C and kept at this temperature for a week. Before using, the frozen hen carcasses were thawed at 4 C and disected from all the fat and the bones. The average pH of hen meat was 5.63. The beef was obtained from Izmir municipal slaughter house after rigormortis. The beef was frozen similarly at 18 C and kept at this temperature for a week. Before using, the frozen beef was thawed at 4 C and trimmed of all the fat. The average pH of beef was 5.75.

Sucuk production was carried out in five groups. There was 100% beef in the first group, 75% beef and 25% hen in the second, 50% beef and 50% hen in the third, 25% beef and 75% hen in the fourth and 100% hen in the fifth. For each proportion of beef and hen meats four different nitrite levels namely 0, 50, 100 and 200 ppm were used. Each experiment was carried out four times. Sucuk was prepared by using meat which was combined in the five groups and also other additives according to the following formulation:

| | |
|---|---|
| Meat | 20kg |
| Beef fat | 6kg |
| Salt | 500g |
| Sucrose | 50g |
| Garlic(fresh) | 200g |
| Black pepper | 100g |
| Allspice | 100g |
| Red pepper | 60g |
| Cumin | 300g |

The samples of sucuk were prepared by using the conventional method with the addition of a pasteurisation step at 65 C because of the possible high levels of Salmonellae in hen meat. The sucuk meat was grinded using 3 mm

grinder plate and mixed thoroughly with curing ingredients, spices and garlic. Then the sucuk mixtures were stuffed into 47 mm diameter 200 mm long moisture impermeable Naturin casings. After stuffing, the sucuks were incubated at 4 C for 24 hours and pasteurizated at 65 C in a hot cabinet. The drying process was carried out at 20 C. At the beginning of drying, the relative humidity was 90%, and it was decreased gradually to 70% in the following days. Drying was stopped when the moisture content reached 40%. The samples were vacuum packed into polyamide/polyethylene bags.

The pH value and the amount of lactic acid were determined in the mix, after fermentation, after pasteurisation and once in each day of the 8 days drying period. The amount of residual nitrite, the thiobarbituric acid(TBA) value were measured in the mix, after fermentation, after pasteurisation and in the final products. The water content, the fat and the protein content were determined in the final products. The pH value was measured electrometrically using sonda electrodes. Lactic acid content was determined by titrimetric method according to Keller and Acton(1974). Residual nitrite was determined spectrophotometrically according to Pearson(1973). The TBA value was determined by the methods of Tarladgis et al. (1960). The moisture content and protein (Kjeldahl) were determined according to AOAC (1975). The fat content was determined according to the method of Flyn and Bramblet (1975). The yield was calculated by dividing the final weight by the stuffed sucuk weight. Sensory evaluation was carried out on heattreated (grilled)sucuk slices by a seven-score hedonic scale with 7 excellent ones and 1 unacceptable one. The data was analysed by the standard statistical variance analysis techniques as described by Steele and Torrie(1960).

## RESULTS AND DISCUSSION

The pH values of all the groups which were measured at different stages are shown in Table 1. In all the samples pH value decreased significantly with increasing amount of hen meat.

Table 1. pH values at different stages of sucuk production.

| Samples | | Time** | | | |
|---|---|---|---|---|---|
| Nitrite** (ppm) | Hen Meat** % | Before Ferm. | After Ferm. | After Pasteu. | Final Product |
| 0 | 0 | 5.71 | 5.05 | 5.27 | 5.14 |
| | 25 | 5.77 | 4.94 | 4.97 | 4.88 |
| | 50 | 5.75 | 4.85 | 4.92 | 4.83 |
| | 75 | 5.70 | 4.74 | 4.80 | 4.75 |
| | 100 | 5.63 | 4.71 | 4.84 | 4.74 |
| 50 | 0 | 5.60 | 5.14 | 5.04 | 4.92 |
| | 25 | 5.60 | 4.80 | 4.91 | 4.88 |
| | 50 | 5.59 | 4.80 | 4.98 | 4.87 |
| | 75 | 5.51 | 4.79 | 4.91 | 4.87 |
| | 100 | 5.53 | 4.70 | 4.87 | 4.80 |
| 100 | 0 | 5.63 | 4.99 | 5.20 | 4.92 |
| | 25 | 5.60 | 4.90 | 4.89 | 4.83 |
| | 50 | 5.61 | 4.85 | 4.72 | 4.70 |
| | 75 | 5.60 | 4.87 | 4.89 | 4.70 |
| | 100 | 5.61 | 4.70 | 4.82 | 4.74 |
| 200 | 0 | 5.66 | 4.90 | 4.94 | 4.85 |
| | 25 | 5.63 | 4.90 | 4.94 | 4.86 |
| | 50 | 5.69 | 4.79 | 4.94 | 4.81 |
| | 75 | 5.70 | 4.85 | 5.04 | 4.86 |
| | 100 | 5.63 | 4.70 | 4.92 | 4.78 |

Significance: NS-non significant ($P>.05$)
*-significant ($P<.05$)
**-significant ($P<.01$)

The muscle characteristics of hen meat and the differences between the pH values of initial meats may be the reasons for this effect. The nitrite levels also affected the pH values significantly.

The amounts of lactic acid in all the groups are given in Table 2.

The initial lactic acid values increased with increasing amounts of hen meat in the groups of the first three nitrite levels. This situation went on until the 2nd drying

day. After the 3rd day, the lactic acid reached its maximum level at the ratio of hen meat of 50% while further increases in the proportion of hen meat (75% and 100% levels) caused lactic acid concentration to fall. In the group of 200 ppm nitrite, increase in lactic acid caused by the increase in the amount of hen meat took place until the 1st drying day and it reached the maximum level with 50% hen meat on the 2nd day. After the 3rd day, lactic acid began to fall with the greater amounts of hen meat.

Table 2. Lactic acid concentration at different stages of sucuk production.

| Samples | | Time** | | | |
|---|---|---|---|---|---|
| NS Nitrite (ppm) | ** Hen Meat % | Before Ferm. | After Ferm. | After Pasteu. | Final Product |
| 0 | 0 | 0.14 | 0.32 | 0.40 | 1.39 |
| | 25 | 0.10 | 0.55 | 0.49 | 1.44 |
| | 50 | 0.19 | 0.56 | 0.60 | 1.47 |
| | 75 | 0.24 | 0.57 | 0.61 | 1.36 |
| | 100 | 0.26 | 0.59 | 0.58 | 1.28 |
| 50 | 0 | 0.15 | 0.52 | 0.53 | 1.42 |
| | 25 | 0.17 | 0.59 | 0.60 | 1.39 |
| | 50 | 0.19 | 0.57 | 0.57 | 1.46 |
| | 75 | 0.26 | 0.57 | 0.56 | 1.16 |
| | 100 | 0.27 | 0.58 | 0.60 | 1.08 |
| 100 | 0 | 0.08 | 0.40 | 0.42 | 1.38 |
| | 25 | 0.12 | 0.46 | 0.57 | 1.30 |
| | 50 | 0.28 | 0.57 | 0.57 | 1.45 |
| | 75 | 0.30 | 0.60 | 0.62 | 1.32 |
| | 100 | 0.30 | 0.61 | 0.61 | 1.23 |
| 200 | 0 | 0.15 | 0.46 | 0.50 | 1.40 |
| | 25 | 0.14 | 0.53 | 0.55 | 1.32 |
| | 50 | 0.28 | 0.49 | 0.59 | 1.23 |
| | 75 | 0.31 | 0.59 | 0.61 | 1.20 |
| | 100 | 0.32 | 0.63 | 0.63 | 1.31 |

Significance:NS-non significant(P>.05)
*-significant (P<.05)
**-significant (P<.01)

Although the amount of hen meat and time have significant effects on increasing lactic acid, the nitrite level has no significant effect.
The factors affecting the lactic acid amount in a fermented meat product are the amount of salt, the amount and type of spice (Deketelare et al. 1974), the type of meat, the amount of initial lactic acid and the amount of lactic acid bacteria (Zaika et al.,1978; Nordal and Slinde,1980).
Residual nitrites of all the groups at different stages of production are shown in Table 3.

Table 3. Residual nitrite levels at different stages of sucuk production.

| Sample | | Time** | | | |
|---|---|---|---|---|---|
| ** Nitrite (ppm) | ** Hen meat (%) | Before Ferm. | After Ferm. | After Pasteu. | Final Product |
| 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 25 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 50 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 75 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 100 | 0.00 | 0.00 | 0.00 | 0.00 |
| 50 | 0 | 41.50 | 40.75 | 39.75 | 43.00 |
| | 25 | 45.25 | 37.50 | 40.75 | 37.75 |
| | 50 | 38.00 | 41.25 | 18.25 | 18.00 |
| | 75 | 27.25 | 18.00 | 9.25 | 0.00 |
| | 100 | 0.00 | 0.00 | 0.00 | 0.00 |
| 100 | 0 | 68.25 | 69.75 | 67.75 | 68.00 |
| | 25 | 71.50 | 46.00 | 46.25 | 40.75 |
| | 50 | 44.00 | 46.25 | 38.00 | 28.00 |
| | 75 | 38.25 | 39.25 | 42.75 | 37.25 |
| | 100 | 28.00 | 28.75 | 36.25 | 38.75 |
| 200 | 0 | 68.25 | 65.50 | 64.50 | 70.25 |
| | 25 | 71.75 | 60.25 | 65.00 | 65.25 |
| | 50 | 64.75 | 67.50 | 52.25 | 51.50 |
| | 75 | 53.00 | 55.25 | 57.25 | 47.75 |
| | 100 | 47.50 | 47.75 | 43.00 | 50.00 |

Significance:N.S.-non significant(P>.05)
*-significant (P<.05)
**-significant (P<.01)

In the group containing 50 ppm nitrite, the increase in the amount of hen meat caused a decrease in the amount of residual nitrite during all the steps of production and in the final product.
The initial amounts of residual nitrite in sucuk mixes containing 0, 25, 50, 75 and 100% hen meat to which 50 ppm nitrite had been added were 41.50%, 45.25%, 38.00%, 27.25% and 0.00%, respectively. In all of the different hen meat groups except the ones made up of 100% beef, the nitrite levels showed decreases in the production stages and reached 37.75%, 18.00%, 0.00% and 0.00% for mixes containing 0, 25, 50, 75 and 100% hen meat, respectively. In the samples containing 100 ppm nitrite, increasing hen meat

caused decreasing residual nitrite level. In this nitrite group the initial residual nitrite levels were 68.23%, 71.50%, 44.00%, 38.25% and 28.00% at the beginning for mixes containing 0, 25, 50, 75 and 100% hen meat, respectively. These values of residual nitrite reached the final values of 68.00%, 40.75%, 28.00%, 37.25% and 38.75%, respectively. As it is seen the least amount of residual nitrite is in the final product made up of 50% hen meat.

Table 4. TBA values at different stages of sucuk production.

| Sample | | Time ** | | | |
|---|---|---|---|---|---|
| Nit.** ppm | Hen Meat ** | Before Ferm. | After Ferm. | After Pasteu. | Final Product |
| 0 | 0 | 0.1970 | 0.1814 | 0.1560 | 0.2477 |
| | 25 | 0.3764 | 0.2633 | 0.2067 | 0.2615 |
| | 50 | 0.5365 | 0.5253 | 0.5051 | 0.5850 |
| | 75 | 0.6850 | 0.5760 | 0.7020 | 0.6848 |
| | 100 | 0.6708 | 0.5831 | 0.7118 | 0.6357 |
| 50 | 0 | 0.3413 | 0.5285 | 0.5616 | 0.7118 |
| | 25 | 0.3608 | 0.3647 | 0.4524 | 0.4875 |
| | 50 | 0.3939 | 0.3861 | 0.7137 | 0.6728 |
| | 75 | 0.6221 | 0.4895 | 0.5616 | 0.7118 |
| | 100 | 0.6942 | 0.7625 | 0.6104 | 0.6318 |
| 100 | 0 | 0.1326 | 0.1580 | 0.2145 | 0.1619 |
| | 25 | 0.1601 | 0.1716 | 0.2282 | 0.2945 |
| | 50 | 0.2574 | 0.2945 | 0.2452 | 0.4622 |
| | 75 | 0.3588 | 0.4407 | 0.4563 | 0.6786 |
| | 100 | 0.6669 | 0.6240 | 0.6377 | 0.7079 |
| 200 | 0 | 0.1638 | 0.2165 | 0.2301 | 0.2126 |
| | 25 | 0.2769 | 0.2574 | 0.2340 | 0.2730 |
| | 50 | 0.3179 | 0.2847 | 0.3510 | 0.3939 |
| | 75 | 0.4076 | 0.4485 | 0.4154 | 0.4290 |
| | 100 | 0.4275 | 0.4681 | 0.4681 | 0.4836 |

Significance: N.S.-non significant ($P>.05$)
*-significant ($P<.05$)
**-Significant ($P<.01$)

In the group of 200 ppm nitrite the nitrite level was found to be unnecessarily high. In this group of the final products residual nitrite levels were found to be 70.25%, 65.25%, 51.50%, 47.75% and 50.00% in the order of increasing proportions of hen meat. The percentage of hen meat, the amount of nitrite and time were found to have significant effects on residual nitrite amounts.

TBA values of all the groups at different production stages are given in Table 4. TBA values increased with increasing hen meat, decreasing nitrite level and also with increasing time. In the products, produced using 100% beef, and 25% and 50% hen, the addition of 100 ppm nitrite caused a decrease in TBA value while in the 75% and 100% hen meat groups 200 ppm nitrite addition was necessary for decreasing TBA value. The percentage of hen meat, nitrite level and time were found to have significant effects on TBA value, as to be seen in Table 4.

In Table 5, the water and fat contents, and weight losses of final products with different nitrite levels and percentages of hen meat are shown. Using increasing hen meat and nitrite levels had a significant effect on water content. Increasing hen meat caused a decrease in the water content of the product. Increasing the nitrite level also had the same effect. The protein amounts of products increased slightly but significantly with the increasing nitrite level. On the other hand, the protein amount was decreased by using increasing proportion of hen meat. On the average there were 19.21% protein in 100% beef group, 19.02% in 25% hen group, 18.32% in 50% hen group, 16.57% in 75% hen group and 15.38% in 100% hen group. These decreases are significant ($P < .01$) as can be seen in Table 5.Fat contents changed with the

different ratios of hen meat. While it was found to be about 11.14% in 100% beef group, it reached the levels of about 10.90% in 25%hen meat, 12.00% in 50% hen meat, 13.11% in 75% hen meat and 14.90% in 100% hen meat.

Table 5. Proximate composition and loss of weight during production of different sucuks.

| Hen Meat % | Nitrite (ppm) | Water Cont.% Meat ** Nitrite | Prot. % Meat ** Nitrite | Fat % Meat ** Nitrite | Loss of Weight% Meat ** NS Nitrite |
|---|---|---|---|---|---|
| 0 | 0 | 54.81 | 18.70 | 11.07 | 13.35 |
| | 50 | 55.27 | 19.27 | 11.12 | 17.81 |
| | 100 | 55.00 | 14.80 | 11.17 | 14.88 |
| | 200 | 55.86 | 19.05 | 11.20 | 12.68 |
| 25 | 0 | 52.32 | 18.97 | 10.22 | 21.08 |
| | 50 | 54.50 | 20.02 | 10.45 | 18.88 |
| | 100 | 53.98 | 14.02 | 11.25 | 18.50 |
| | 200 | 54.01 | 18.07 | 11.67 | 17.73 |
| 50 | 0 | 52.58 | 18.25 | 12.25 | 20.15 |
| | 50 | 53.52 | 18.50 | 12.57 | 20.36 |
| | 100 | 53.27 | 17.75 | 12.40 | 20.10 |
| | 200 | 56.52 | 18.77 | 10.77 | 22.79 |
| 75 | 0 | 50.44 | 15.20 | 15.32 | 23.59 |
| | 50 | 52.70 | 16.95 | 11.97 | 21.80 |
| | 100 | 52.39 | 16.37 | 12.87 | 20.97 |
| | 200 | 55.73 | 17.75 | 12.25 | 22.78 |
| 100 | 0 | 51.55 | 15.15 | 15.73 | 22.98 |
| | 50 | 52.63 | 15.77 | 14.55 | 22.03 |
| | 100 | 53.00 | 14.90 | 15.30 | 22.29 |
| | 200 | 54.09 | 15.67 | 14.02 | 23.17 |

Significance:NS-non significant(P>.05)
*-significant (P<.05)
**-significant (P<.01)

The loss of weight changed with the usage of hen meat.Hen meat had a negative effect on product yield. While the loss of weight was found to be about 14.68% in the beef group, the others have increasing weight losses, namely, 19.05%, 20.85%, 22.29% and 22.62% in hen meat proportions of 25, 50, 75 and 100%, respectively.As it is seen in Table 5, the meat type or the usage of hen meat has significant effect on the weight loss. The results of sensory evaluations of all the groups is given in Table 6. Color was affected by increasing amounts of hen meat and nitrite. The increasing amount of hen meat caused decreasing color grade especially when 75% and 100% hen meat are used. Also the increasing nitrite levels gave a better color to the product. It is seen in Table 6 that using hen meat and nitrite have significant effects on color grades. As a result, only the groups containing 100% beef, 25% hen and 50% hen were found acceptable for their color grades. It is well known that the myoglobin content of meat and the nitrite level are important factors on color of product (Wilson, 1960; Tömek, 1986). This may be the reason that the groups of 100% beef and up to 50% hen meat had high color points. Use of hen meat and nitrite did not have consistent effects on the texture of products, although a somewhat significant effect was observed. Korschegen et al. (1978) and Olson et al. (1978) indicated that the increasing nitrite level have a smooth effect on texture. In the same way,the results of the present study showed that 50 ppm was sufficient with 100% beef but in the other samples which were prepared with different percentages of hen meat, this nitrite level was not sufficient. For these samples 100 ppm or 200 ppm nitrite was to be used. There were significant differences of flavor between different percentages of hen meat and different nitrite levels. 50 ppm nitrite was found to be successful on the flavor of sucuk made from 100% beef. But in the hen meat groups 100 ppm and 200

ppm nitrite had to be used to reach a good flavor. It is reported that different nitrite concentrations give different flavor results. Generally 100 and 150 ppm nitrite levels were recommended to obtain a good flavor (Wasserman and Talley, 1972; Dethmers et al.,1975; Shults et al.,1977; Olson et al.,1978; Price and Gregne, 1978).

Table 6. Sensory evaluation results of different sucuks.

| Hen Meat % | Nitrite (ppm) | Color | Texture | Flavor | General Accept. |
|---|---|---|---|---|---|
| | | Meat Nitrite ** | Meat Nitrite * | Meat Nitrite * | Meat Nitrite * |
| 0 | 0 | 5.018 | 4.521 | 4.787 | 4.882 |
| | 50 | 5.692 | 5.130 | 5.220 | 5.112 |
| | 100 | 5.909 | 4.567 | 5.283 | 5.149 |
| | 200 | 5.420 | 4.477 | 4.659 | 4.837 |
| 25 | 0 | 5.031 | 4.451 | 4.433 | 4.522 |
| | 50 | 4.897 | 4.108 | 4.484 | 4.163 |
| | 100 | 5.854 | 4.587 | 4.686 | 4.750 |
| | 200 | 6.055 | 4.462 | 4.170 | 5.078 |
| 50 | 0 | 5.161 | 4.381 | 4.341 | 4.610 |
| | 50 | 5.347 | 3.973 | 3.933 | 3.961 |
| | 100 | 5.426 | 4.427 | 4.588 | 4.892 |
| | 200 | 5.825 | 5.154 | 5.034 | 5.269 |
| 75 | 0 | 4.581 | 4.338 | 4.206 | 4.489 |
| | 50 | 4.447 | 4.028 | 4.324 | 4.341 |
| | 100 | 4.654 | 4.640 | 4.792 | 4.884 |
| | 200 | 4.605 | 4.382 | 4.820 | 4.504 |
| 100 | 0 | 4.948 | 4.391 | 4.711 | 4.650 |
| | 50 | 4.755 | 3.883 | 4.103 | 4.184 |
| | 100 | 4.839 | 4.437 | 4.958 | 4.932 |
| | 200 | 4.466 | 4.314 | 4.059 | 4.326 |

Significance:N.S.-non significant(P>.05)
*-significant (P<.05)
**-significant (P<.01)
Scoring:7-excellent,1-unacceptable.

General acceptability was also affected by the nitrite and hen meat levels. 50 ppm nitrite level was found to be sufficient in 100% beef for obtaining a good result. But if formulation has certain amounts of hen meat, this nitrite level was not sufficient. 100 and 200 ppm nitrite gave a good result for its acceptability when hen meat was used in the formulation.

## CONCLUSION

The results of the present study indicated that part of beef used in sucuk production can be substituted with hen meat. Using hen meat was found to increase the rate of fermentation, therefore a somewhat shorter production process would be suitable. Hen meat also had a decreasing effect on the moisture content of the product. The residual nitrite contents of the products containing some percentage of hen meat were found to be lowest.Sucuk with 25 or 50% hen meat and 100 ppm nitrite level was found to be the most recommendable combination, while the use of 75 or 100% hen meat did not yield acceptable products.

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