TECHNOLOGICAL, CHEMICAL, SENSORY, AND
MICROBIOLOGICAL EXAMINATION OF FROZEN CHICKEN AS
AFFECTED BY MICROWAVE THAWING

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Abstract: The effect of microwave heating as a thawing method on physical, chemical, sensory, and microbiological properties of frozen chicken was investigated in comparison with other thawing methods (at ambient temperature, in refrigerator, and in running tap water). Microwave thawed chicken had the highest taste panel scores and the lowest drip percentage loss compared with the other thawing methods. Thiobarbituric acid value (TBA) remarkably increased the samples thawed at ambient temperature or under running water. The data revealed that the retention of thiamin was the highest in the microwave thawed samples (97.33%) and the lowest in running water thawed samples (66.66%). The total bacterial count in frozen chicken remarkably decreased as a result of microwave thawing treatment while increased in the other treatments.

Key words: Microwave, thawing, chicken, frozen.

Introduction

Thawing is a kind of heat treatment generally applied to food products. This is common practice when such products are to be frozen. Since conventional thawing using water, or other methods as a heating medium have disadvantages such as long thawing time, large space requirement, and could cause several problems to the final product as growth of bacteria, drip loss, surface oxidation, discoloration of the product as well as consumption of high amount of water and leaching of solids which leads to an ultimate loss of product, a more gentle thawing
process with more efficient heating could have positive effect on the yield and quality of the finished product (Odland, and Eheart, 1974; Maeda, and Salunkhe, 1981; Baldwin et al., 1986; Sanchez-Pineda-Infantas et al., 1994; Godfrey Usiak et al., 1995; and Shamaila et al., 1996). The application of microwave heating for food processing provides potential advantages such as retention of product quality and improvement of process efficiency (Copson, 1975; Gullett et al., 1984; Araya et al., 1990; and Van Remmen et al., 1996). In microwave treatment, as with any other technique, the product composition is decisive for the amount of microbial reduction (Rosenberg and Bogl, 1987).

Several researchers compared thiamin content of beef roasts cooked at low power level in a microwave oven with that of conventionally soaked roasts and found that the thiamin content of meat did not differ significantly. Hoffman and Zabik (1985) concluded that microwave cooking at reduced power level can result in thiamin retention equal to that in other cooking procedures. The thiobarbituric acid assay (TBA) is the popular chemical method for measuring oxidative rancidity of meat and was found to be highly correlated with sensory scores of oxidizing and warmed over flavor in meats (Pearson et al., 1983).

The objective of this study is to compare the use of microwave thawing method with other methods of thawing on chemical, microbiological, and sensory properties of frozen chicken.

Materials and methods

Sample preparation:
Fifteen large chickens (1900 ±100 g each) were obtained from local market. The chickens were slaughtered, cleaned, scalded and feather removed, then washed thoroughly and cut into four parts and formed in a block shape with dimensions (25 X 18 X 18 cm) and (2100±150 g) weight, then packaged in low density polyethylene bags, and placed in a freezer at (−40 °C) for (4 hours), then kept at (− 18 °C) for (ten days).

Thawing procedure:
Four methods of thawing were used for the frozen chicken:
Ambient ( 28± 4 °C); in refrigerator at (4 °C); submerging under running tap water at room temperature; and in domestic type microwave (Samsung Mw/ 121314 with cooking power 500 w). Immediately after
each thawing treatment, the thawed blocks were weighed in order to calculate the percentage of weight loss during thawing. Drip volume and percentage of drip loss were measured (as % of chicken weight before thawing). The thawed chicken were then cooked for (35 min.) at (220°C) in an electric oven, then used for sensory evaluation.

**Sensory evaluation:**
Color, flavor, tenderness, and juiciness of the cooked samples were evaluated by 20 semi-trained panelists who were asked to rank the samples on a numerical hedonic scale of 1 (very poor); 2-3 (poor); 4-5 (fair); 6-7 (good); 8 (very good); and 9 (excellent) (*Stone and Sidel, 1993*).

**Proximate analysis:**
Moisture, crude protein, ether extract, and ash content of the thawed chicken samples were determined according to AOAC (1995).

**Thiamin content:**
Thiamin content was estimated by the method of *Morris (1958)*. Thiamin retention was adjusted to account for weight loss during thawing processing according to the equation recommended by *Murphy et al. (1975)*.

**Thiobarbituric acid (TBA) value:**
Frozen and thawed chicken samples were tested separately in triplicate. TBA-reactive substances were measured using the method of *Harold et al. (1981)*. Colorimetric absorbance at 530 nm was measured using a Spectronic 710 Spectrophotometer. Readings were converted to mg malonaldehyde /1000g meat product (multiply by 7.6) and reported as TBA values (mg TBA/1000g meat product).

**Microbiological test:**
Total aerobic count, and proteolytic bacterial count were determined and reported as (CFU/g) according to the methods described in the standard methods of (APHA, 1985; and *Vanderzant and Splittstoesser, 1992*).

**Statistical analysis:**
The data were statistically analyzed by analysis of variance ANOVA (*Steel and Torric, 1980; Gill, 1981*).
Results and discussion

Table 1 shows the time needed for every thawing method. The microwave thawing has the shortest thawing time (36 min.) compared to the time needed for thawing in refrigerator (10 hrs.). The method of thawing affects the amount of drip and the drip loss from meat which is also reported in (Table 1). Drip loss from microwave thawed chicken was the smallest compared to the other thawing methods, whereas, thawing at ambient temperature had the highest percentage of loss before and after cooking.

Table 1. Effect of different methods of thawing on thawing time, drip volume, and percentage of loss before and after cooking
Tabla 1. Uticaj različitih metoda odmrzavanja na vreme odmrzavanja, obim kapanja i kalo pre kuvanja

<table>
<thead>
<tr>
<th>Thawing treatment / Tretman odmrzavanja</th>
<th>Thawing time/ Vreme odmrzavanja</th>
<th>Drip volume / Obim kapanja, ml</th>
<th>Percentage of loss/Kalo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave / Mikro talasna pećnica</td>
<td>36 min.</td>
<td>7.0</td>
<td>1.99 %</td>
</tr>
<tr>
<td>Refrigerator / Frižider</td>
<td>10 hrs.</td>
<td>13.0</td>
<td>2.39 %</td>
</tr>
<tr>
<td>Ambient temp. / Sobna temp.</td>
<td>4 hrs.</td>
<td>22.5</td>
<td>15.23 %</td>
</tr>
<tr>
<td>Tap water / Voda iz slavine</td>
<td>2.5 hrs.</td>
<td>49.5</td>
<td>8.62 %</td>
</tr>
</tbody>
</table>

Table 2 illustrates the proximate composition of frozen and cooked chicken thawed by different methods. The data revealed that protein and ether extract contents of chicken thawed under tap water were the lowest compared with the other thawing methods. This may be due to leaching out of some soluble nutrients in the water. Thawing by microwave or in refrigerator has no change in the crude protein, the ether extract, and the ash contents. It appears that heating in microwave oven may be considered to yield comparable nutrient retention value (Hoffman and Zabik, 1985).
Table 2. Proximate composition of frozen and cooked chicken thawed by different methods

Tabela 2. Približni sastav zamrznutog i kuvanog pilećeg mesa odmrznutog različitim metodama

<table>
<thead>
<tr>
<th>Thawing treatment/Tretman odmrzavanja</th>
<th>Moisture / Vlažnost (%)</th>
<th>Crude protein / Sirovi protein, %</th>
<th>Ether extract / Eter ekstrakt, %</th>
<th>Ash / Pepeo %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave/Mikro talasna pećnica</td>
<td>66±1.29</td>
<td>24.9±0.82</td>
<td>3.5±0.32</td>
<td>1.20±0.10</td>
</tr>
<tr>
<td>Refrigerator/Frižider</td>
<td>62±1.31</td>
<td>24.8±0.75</td>
<td>3.5±0.42</td>
<td>1.25±0.19</td>
</tr>
<tr>
<td>Ambient temp./Sobna temp.</td>
<td>65±1.60</td>
<td>23.5±0.90</td>
<td>3.3±0.40</td>
<td>1.25±0.13</td>
</tr>
<tr>
<td>Tap water/Voda iz slavine</td>
<td>78±1.01</td>
<td>22.1±0.91</td>
<td>3.0±0.55</td>
<td>1.10±0.12</td>
</tr>
<tr>
<td>Frozen/Zamrznuta</td>
<td>67±1.81</td>
<td>24.8±0.80</td>
<td>3.4±0.38</td>
<td>1.30±0.15</td>
</tr>
</tbody>
</table>

Table 3 illustrates the TBA value, thiamin content and thiamin retention in frozen and cooked chicken thawed by different methods. Higher (TBA) values were found for chicken thawed at ambient temperature and under running tap water compared with thawing in microwave or in refrigerator. Long period of thawing under higher temperature (room or tap water), allowed lipid oxidation and thus increase of the TBA values. There is a high correlation (r= 0.795) between TBA value and the panel scores for flavor of cooked chicken. TBA values also were used as a measurement of development of warmed over flavor in cooked beef (St.Anglo et al., 1987; Nolan et al., 1989; and Hwang et al., 1990). Thiamin content as (mg/g) of chicken meat was the highest in the samples thawed by microwave, whereas, the lowest content was for the sample thawed under running tap water due to the leaching out of the thiamin in the water.

Table 3. Thiobarbituric acid value (TBA), thiamin content, and thiamin retention in frozen and cooked chicken thawed by different methods

Tabela 3. Tiobarbiturna kiselina (TBA), sadržaj tiamina I zadržavanje tiamina u zamrznutom i kuvanom pilećem mesu odmrznutom različitim metodama

<table>
<thead>
<tr>
<th>Thawing treatment/Tretman odmrzavanja</th>
<th>TBA value / TBA vrednost (mg/kg)</th>
<th>Tiamin content / Sadržaj tiamina (mg/g)</th>
<th>Tiamin retention / Zadržavanje tiamina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave/Mikro talasna pećnica</td>
<td>3.69</td>
<td>73</td>
<td>97.33</td>
</tr>
<tr>
<td>Refrigerator/Frižider</td>
<td>3.51</td>
<td>72</td>
<td>96.00</td>
</tr>
<tr>
<td>Ambient temp./Sobna temp.</td>
<td>5.02</td>
<td>65</td>
<td>86.66</td>
</tr>
<tr>
<td>Tap water/Voda iz slavine</td>
<td>4.93</td>
<td>50</td>
<td>66.66</td>
</tr>
<tr>
<td>Frozen/Zamrznuta</td>
<td>3.74</td>
<td>75</td>
<td>.....</td>
</tr>
</tbody>
</table>
Figure 1 illustrates the sensory evaluation values for the cooked chicken samples expressed to different thawing methods. The data revealed that chicken thawed by microwave had the highest values for color, flavor tenderness, and juiciness followed by the samples thawed in refrigerator, on the other hand, sample thawed by tap water had the remarkably lowest organoleptic scores. These results may be due to the leaching of the nutrients and flavor compounds into the drip solution during the thawing process (Rasenberg and Bogl, 1987).

Figure 1. Taste panel score for cooked chicken thawed by different methods (MW) microwave, (REF.) refrigerator, (Amb.) ambient temperature, and (Tw.) tap water

Slika 1. Rezultati panela koji se odnosio na ukus kuvanog pilećeg mesa odmrznutog različitim metodama (MW) mikrotalasna pečnica, (REF.) frižider, (Amb.) sobna temperatura, i (Tw.) voda iz slavine
Results of total plate count (CFU/g) and proteolytic bacterial count (CFU/g) for frozen and chicken thawed by different methods are shown in Fig. 2. Bacterial number of frozen chicken decreased remarkably as a result of thawing by microwave. Whereas, thawing in tap water or at ambient temperature increased the bacterial total count and the proteolytic bacterial count as well. This is due to the longer time of thawing at high temperature which permits rapid microbial growth. Fung et al., (1980) found that heat generated by microwaves kills naturally occurring microorganisms.

In conclusion, comparing between different methods of thawing (microwave, ambient, in refrigerator, and under running tap water) for frozen chicken indicated that microwave is the best condition and caused a remarkable reduction in the amount of drip, thiamin loss, and microorganism growth. It also retained the organoleptic properties and the food nutrients.
TEHNOLOŠKO, HEMIJSKO, SENZORNO I MIKROBIOLOŠKO ISPITIVANJE ZAMRZNUTOG PILEĆEG MESA I UTICAJ ODMRZAVANJA U MIKROTALSNJOJ PEĆNICI

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Rezime

Uticaj odmrzavanja u mikrotalnsnoj pećnici kao metode odmrzavanja na fizičke, hemijske, senzorne i mikrobiološke osobine zamrznutog pilećeg mesa je ispitivano u radu poređenjem sa drugim metodama odmrzavanja (na sobnoj temperature, u frižideru, i u vodi iz slavine). Pileće meso odmrznuto u mikrotalnsnoj pećnici je imalo najbolje rezultate na panelu koji se odnosio na ukus i najmanji kalo u poređenju sa ostalim metodama. Vrednost tiobarbiturne kiseline (TBA) je znatno povećana u uzorcima koji su odmrznuti na sobnoj temperature ili u vodi iz slavine. Podaci koje se odnose na zadržavanje tiamina su bili najveći kod uzoraka odmrznutih u mikrotalasnoj pećnici (97.33%) a najniži kod uzoraka odmrznutih u tekućoj vodi (66.66%). Ukupni broj bakterija u zamrznutom pilećem mesu je znatno opadao kao rezultat odmrzavanja u mikrotalnsnoj pećnici dok je kod ostalih tretmana bio povećan.

Key words: Microwave, thawing, chicken, frozen.

References

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