

## **Evaluation of Waterless Cookware on an Induction Cooktop**

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### **Abstract**

This student-faculty collaborative study compared the effects of different cookware using induction and electric cooktops on overall qualities of chicken breasts including shrinkage, palatability, and consumer acceptability. Four trials of cooking boneless, skinless, chicken breasts on each of these various cooktops were conducted to get an average shrink loss (i.e., weight and length change), taste, texture, and appearance. Objective tests resulted in lowest shrink loss and highest texture and appearance score for the high-end stainless steel cookware on an induction cooktop.

Recent innovations in cooking methodology and cookware products have caught the attention of food scientists concerned with various assessments of food quality. Induction cooktops employ a powerful, high frequency, electromagnetic type of cooking. The field penetrates the metal of the ferrous (magnetic-material) cooking vessel and sets up a circulating electric current, which generates heat and then transfers the heat into the metal of the cookware and to the food or liquid inside. This is the major difference between induction cooking and electric or gas cooking; the heat is generated directly in the pot or pan itself and not in any part of the cooker (The Owlcroft Company, 2007; Varkonyi-Schaub, 2006). The most obvious and well-known drawback to induction cooking is it only works with cookware made of magnetic materials including stainless steel, aluminum, and cast iron. A type of cookware that does work with induction cooktops is waterless cookware, for example the high quality stainless steel cookware (HQ) used in this study is advertised as waterless cookware priced at over \$1000 for a basic set.

Literature that examines advantages of waterless cooking is forty or more years old. As early as the 1940's, waterless cookware that involved the use of heavy aluminum utensils designed to decrease the amount of water used to cook food was studied (Borchgrevink & Charley, 1966; Charles & Van Duyne, 1954; Gordon & Noble, 1964; Loeffler & Ponting, 1942). This type of cooking is especially nutritious; studies have shown an inverse relationship between the amount of cooking water and the retention of nutrients in vegetables (Charles & Van Duyne, 1954).

More recent articles comparing cooking methods have also focused on nutrient retention of vegetables and energy consumption (Driskell, Nunn, Giraud, & Hamouz, 2006; Martinsen & Ostrander, 1984 ) as well as characteristics of pork-loin when roasting (Hamouz, Mandigo, Driskell, Sun, & Batenhorst, 1995). A comparison of induction, conventional, and microwave cooking of vegetables in 2006 (Driskell, Nun, Giraud, & Hamouz) revealed few flavor differences of vegetables cooked in these three ways. However, the study noted the advantages of using induction cooking for energy conservation. Sensory tests revealed high scores for vegetables prepared by induction stir-frying in a 2007 study (Rajagopal, Giraud, Homouz, & Driskell). There have been studies done on vegetables with various methods, but little has been reported regarding waterless cookware on an induction cooktop with meat . Currently, the price of induction cooktops varies from \$1,799 to \$3,650, but prices are expected to fall within the next years. There are also single induction cooktops available under \$200 for those consumers who are looking for inexpensive, portable cooking methods. Thus, with the likely increase in consumer interest in quality waterless cookware, and the paucity of research regarding different cooking options with meats, the present study compared the effects of different cookware using induction and electric cooktops on overall qualities of chicken breasts including shrinkage, taste, texture, and appearance.

Based upon the literature reviewed above, we hypothesized that skinless and boneless chicken breasts, cooked in the high quality waterless cookware on an induction cooktop, would exhibit a more desirable appearance, taste, texture, and less shrinkage relative to other more common cooking methods. To determine if this hypothesis was correct, we compared the differences among these qualities of chicken breasts prepared in different cookware and on different cooktops using averages from four trials, based primarily upon results from a consumer taste panel. The cooking methods included high quality waterless cookware (HQ Induction and HQ Stovetop), a stovetop manufacturer's waterless cookware on its own induction cooktop (MP Induction), and generic cookware from the University foods lab on an electric stovetop (LC Stovetop).

### **Method**

To compare our outcome measures, four trials were completed for each of the four cooking methods.

The procedures were as follows:

1. Place selected cookware on desired cooktops device:

Product 1: High-end stainless steel waterless cookware cooking on induction cooktops

Product 2: High-end stainless steel waterless cookware on electric stovetop

Product 3: Induction manufacturer's pan on induction cook-top

Product 4: Nonstick standard pan on electric stovetop

2. Remove skin from chicken breast.
3. Weigh chicken breast.
4. Measure thickness and length of chicken breast using a ruler.
5. Turn on cook-top device.
6. Place chicken breast in cookware, cover and begin timing.
7. Cook on one side until it is golden brown or un-sticks and flip on other side to continue cooking.
8. After the other side is golden brown, measure the internal temperature of chicken breast by placing the thermometer in the center of the meat making sure not to touch the pan with the thermometer, and cook until it just reaches 165 degrees Fahrenheit. Once temperature achieved record cook time, remove from pan and measure on scale for weight.
9. Measure and record thickness and length of chicken breast using a ruler.
10. Repeat steps 1-8 with the other products, use Pam or other non-stick spray (without calories) on standard cookware if necessary (1 serving).

To assess taste, texture, and appearance, a consumer taste panel was used. The taste panel included area residents over the age of 18, including temporary residents (students). The research project was approved by the University's Institutional Review Board (Committee on Human Subjects in Research) in February 2008. Research members recruited a convenience sample for the taste panel subjects through word-of-mouth. In all, 10 participants agreed to take part in the taste panel and each participant was informed of all study procedures and protocol. An informed consent form was distributed to all participants at the time of the taste panel. Each participant read and signed the informed consent before completing the taste panel. Any questions the participants had were addressed at the taste panel. No participant was included in the study until they read the informed consent, understood the protocol, and signed the consent form. Those participants who were not willing to sign the informed consent or were not local residents were excluded from the taste panel. The evaluations of the chicken breasts by the taste panel were recorded, but only first names were used. Participation in the taste panel was completely voluntary and privacy was maintained. The participants filled out the survey indicating a 1-5 score for taste (1 = poor flavor, to 5 = excellent flavor), texture (1 = too tough, to 5 = very tender), and appearance (1= poor, to 5 = excellent).

## **Results**

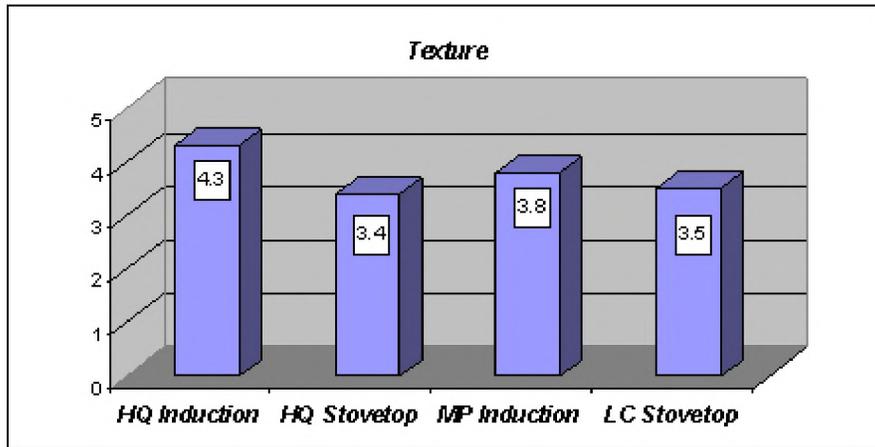
Using SPSS 15.0, we conducted a one-way repeated measures analysis of variance test for each outcome: taste, texture, and appearance. Results (see Table 1) indicated significant results for texture, Wilk's Lambda (3,7) = .295,  $p = .029$ ,  $\eta^2 = .71$ ; and for appearance, Wilk's Lambda (3,7) = .186,  $p = .006$ ,  $\eta^2 = .81$ ; no significant results were found for taste. The assumption of sphericity was not violated for any test. Pairwise comparisons (Bonferroni adjustment) for texture (see Figure 1) showed that the average score for quality waterless cookware (HQ) on Induction (4.3) was significantly larger than HQ Stovetop (3.4) at  $p = .023$ ; the other comparisons were not significantly different. Similar comparisons for appearance (see Figure 2) showed that HQ Induction (4.6) was significantly larger than HQ Stovetop (3.3),  $p = .02$ , and than MP Induction (2.6),  $p = .002$ . Also, LC Stovetop (4.2) was significantly larger than MP Induction,  $p = .03$ .

The trial results of percent shrink loss were determined by averaging the percent change of length and width of the chicken breasts in the four trials for each cooking method. The results show that HQ Stovetop had the least amount of shrink loss (27.66%) compared to MP Induction (35.04%), and HQ Induction (37.50%). The greatest percent of shrink loss was LC Stovetop (60%).

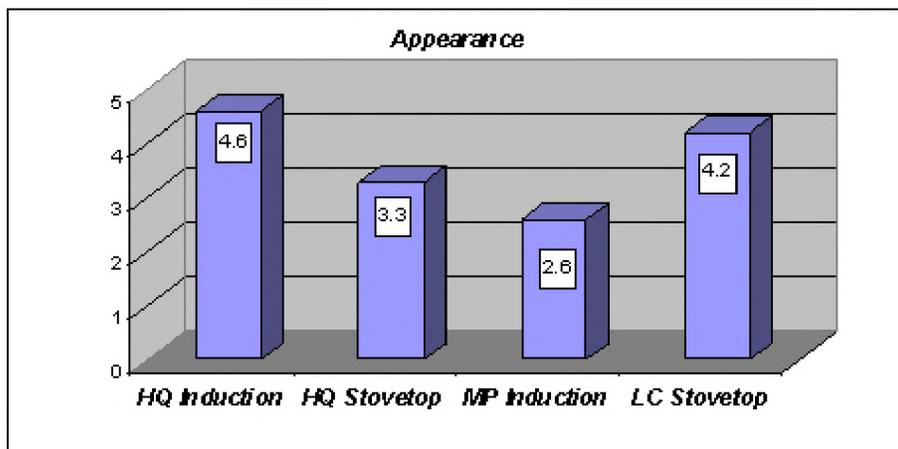
**Table I .** *The descriptive results of the taste panel and trials*

<b>COOKING METHOD RESULTS</b>	<b>HQ Induction</b>	<b>HQ Stovetop</b>	<b>MP Induction</b>	<b>LC Stovetop</b>
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
<b>Taste (scale 1-5)</b>	3.5 (.71)	3.6 (.70)	3.1 (.74)	3.0 (.67)
<b>Texture (scale 1-5)</b>	4.3 (.48)	3.4 (.84)	3.8 (.79)	3.5 (.71)
<b>Appearance (scale 1-5)</b>	4.6 (.97)	3.3 (.95)	2.6 (1.14)	4.2 (1.03)
<b>Percent shrink loss</b>	37.50%	27.66%	35.04%	60%

**Figure I.** *Taste panel texture scoring*



**Figure 2.** Taste panel appearance scoring



## Discussion

Three different types of cookware were used in this research project. Cookware products were provided by two companies who manufactured waterless cookware—one company also manufactured the induction cooktop—and the University foods lab. The high quality stainless steel cookware was used on an induction cooktop and an electric cooktop. The manufacturer's waterless cookware was used on the induction cooktop, and cookware from the University foods lab was tested only on the electric cooktop, due to the fact that the cookware was not appropriate for use with induction cooking. Cookware that is 7-ply has seven layers of stainless steel, making it heavier, more durable, and a compliant product to work on an induction cooking system.

### *High Quality Stainless Steel Waterless Cookware*

The high quality stainless steel cookware (HQ) used in this study was a waterless product made by Americraft. The cookware was a 7-Ply T-304 surgical stainless steel. T-304 stainless steel was part of the austenitic group which was composed of

chromium 18% and nickel 8% (18/8); it has good corrosion resistance due to high molybdenum contents and the addition of nitrogen. The austenitic group can withstand temperatures of 1600 degrees Fahrenheit. The high-end stainless steel cookware pan used in the experiment had a diameter of 6.5 inches and weighed two pounds. The pan also was completely flat on the bottom and constructed of appropriate material for use on an induction cooktop. The chicken prepared in the high quality stainless steel cookware on the induction stovetop was scored the highest by the taste panel for texture and appearance. Chicken prepared in this cookware on the electric stovetop exhibited the lowest percentage of shrink loss.

#### *Cookware Provided by Induction Cooktop Manufacturer*

The manufacturer makes a 1200 W induction cooktop that is made of electric and induction heating components to create a magnetic current on cookware compatible with induction cooktops. When a 1200 W induction cooktop is sold, the manufacturer includes a waterless frying pan (MP). The pan, appropriate for induction cooking, is made from a certain grade of aluminum that is brazed by a heavy stainless steel, and coated by Teflon for product protection and utilization. Teflon, provided by DuPont, is a coating that does not bond with water, therefore creating a non-stick surface. Teflon is a non-reactive agent and should not cause any harm during the cooking process. Like the quality stainless steel cookware, the manufacturer's waterless pan is completely flat on the bottom for induction cooking. The pan weighed 1.6 pounds, and had a diameter of 7.2 inches. Information is not available regarding the type of stainless steel and aluminum used in this cookware. The taste panel participants found the induction cooktop manufacturer's cookware to be the second best choice for texture and appearance. This cookware on the induction top had the next to lowest shrink loss percentage (e.g., about 35 %).

#### *University Foods Lab Cookware*

The cookware provided by the University foods lab (LC) is over 25 years old and information regarding the composition of the product was not available. This cookware had the lowest score on taste, and close to the lowest score on texture. This could be due to oil that was required for this cookware so the chicken breast would not stick.

According to the results, the cooktop and cooking method with overall acceptability was the high quality waterless cookware on the induction cooktop. It is assumed that this overall acceptability was due to the material and quality of the pan and the method (i.e., waterless on induction) as this method received the highest or close to the highest (although, not necessarily significantly higher) score on each outcome, taste, texture, and appearance. The tight seal cover of this pan's lid allowed all moisture to remain in the pan during the entire cooking process resulting in a tender product. Although induction stovetop manufacture makes a waterless pan for induction cooking, we believe its product was less acceptable by the panelists due to the fact that its cover was made of glass and had a steam release opening. This

opening allowed for moisture to escape and resulted in a product that was less juicy and tender than the HQ product. The other cookware provided by the University foods lab (LC) produced low results in two of the three outcomes (i.e., taste and texture). It is noteworthy that LC stovetop scored relatively low on taste and texture, but second highest on appearance. In this instance, frying on an electric stovetop may look acceptable (but not as acceptable as HQ induction) but not taste as well nor have as tender a texture as the other methods.

## **Limitations**

### *Taste Panel Bias*

Consumers have complex and varying preferences in their food choices. For example, some consumers may prefer a “blackened effect” for chicken rather than the golden brown color as the desired end point. The oil used in the method with the regular cookware (LC stovetop) may have affected the taste of the chicken and the taste panelists’ decisions. Also, every member of the taste panel was female. If there had been males the results could have been different.

### *Inadequate Thermometer*

The thermometers used were not calibrated before the first half of our results. There was some difficulty getting the chicken to the correct temperature even though the chicken was cooked thoroughly, which may have increased the cooking time, and led to an overcooked, drier and less tender chicken breast.

### *Limited Instructions*

There were limited instructions (if any at all) for the cookware. The manufacturer’s induction cookware (MP) had no information on how to use their product correctly and efficiently. For the high quality stainless steel cookware (HQ) there was no information on how to properly cook a plain chicken breast with their product or on the induction cooktop.

### *Cookware Lid*

It was noted during the cooking trials that once the lid from the waterless cookware was removed, it took longer to achieve the correct internal chicken breast temperature. The increased cooking time led to over cooked, drier, and less tender chicken. The manufacturer’s induction cookware came with a clear lid so the cooker can observe their product which made cooking a litter easier, whereas the high quality stainless steel cookware had a metal lid and observation was more difficult.

### *Number of Trials*

The study would be more accurate if more trials were performed. We perfected our method of cooking before we recorded our actual trials, but more trials are necessary to further validate our research results.

### **Conclusion**

Skinless and boneless chicken breasts cooked in a high quality, waterless cookware such as the high quality stainless steel cookware tested in this study, on an induction cooktop, gave chicken breasts a desirable appearance and texture. When the results of different cookware were compared, it was found that the high quality stainless steel cookware on the induction cooktop produced a product with the highest appearance rating according to the consumer taste panel. The high quality, stainless steel cookware tended to receive the highest scores when used in both cooking methods—induction and electric stovetop. In this study, induction cooking, in addition to cooking food more efficiently and using less energy in a safer manner, produced the highest scores for taste, texture, and appearance.

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