MICROWAVE COOKING INNOVATIONS

YOU CAN USE METAL IN A MICROWAVE OVEN

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Imagine, you open your microwave oven door, to take out a freshly baked pie, and find the paper pie plate burning fiercely, ignited by the baked crust. Pie crusts brown and paper ignites at the same temperature. You cannot bake or brown in a paper or plastic container that burns or melts at baking and browning temperatures. You CAN bake a pie and brown food, in a microwave oven, in a metal container.

When metal is used in microwave cooking, the results of gas and electric cooking are obtained. Neither special food packaging nor special formulation of ingredients are required to cook food when metal is used as part of the cooking container in a microwave oven.

Some foods that can be cooked in a microwave oven with the aid of metal are cake, two crust pies, cookies, rolls, biscuits, fruit turnovers, pizza pie from scratch, breaded frozen items such as fried chicken and fried shrimp, rare and medium steaks and hamburgers. Some foods that cook better in a microwave oven when metal is used are whole chicken or chicken parts, precooked frozen pizza pies, frozen prepared dinners and entrees.

Some glass and ceramic dishes become super-heated when exposed to microwave energy. A glass dish can become a puddle of red hot, molten liquid from exposure to microwave energy. Glass and ceramic cookware that contain impurities will crack when used in a microwave oven.

Before you buy glass or ceramic products, for use in your microwave oven, you look for the words, "Microwave Safe" on the product. The words, "Microwave Safe," signifies that a manufacturer has tested its product and determined that its product is safe to use in a microwave oven.

Why don't you use "Microwave Safe" metal dishes? Metal cookware manufacturers should mark pots and pans that have utility in a microwave oven, "Microwave Safe."

Some older microwave ovens displayed a tag that read "Don't use metal in this Microwave Oven!" Let us explore the history of microwave cooking and find out why you have been deceived. Why did the manufacturers warn not to use metal pots and pans in early model microwave ovens?

METAL'S USE IN THE MICROWAVE OVEN

Early, in the history of microwave cooking, the microwave oven manufacturers faced a dilemma. The same dilemma all manufactures face when they introduce a new consumer oriented product. "How do we educate the consumer?" For a consumer to use metal pots or pans (other than those specifically designed for microwave oven use) in their microwave oven, the consumer must understand that:

1. Microwaves can cause an electric arc to appear between two improperly placed pieces of metal. The user's ability, to cause an arc, or prevent an arc, depends on the size and shape, of the metal pieces, their relationship to each other, and the lossiness of the load in the oven cavity.

2. A metal utensil will arc to the oven walls, depending on its size, shape, distance from the oven walls, and the amount of food or other lossy material in the oven cavity.

3. Metal reflects microwaves. A metal pot with a metal cover shields the food, that it contains, from microwave energy. Food, in a metal pot with a metal cover, will not get hot. The dimensions of the metal container in relationship to the size of the food is also important.

4. The black, phenolic handles on metal pots and pans are not "Microwave Safe." Phenolic is a plastic material, that has been used since the early part of this century as handles for metal pots and pans. Phenolic handles explode when exposed to microwaves.

In the early days of microwave cooking, microwave oven manufacturers decided that the "do(s) and don't(s)" of metal, was best left at "do not". The manufacturers felt it was in the best interest of the fledgling industry to avoid educating each, new microwave oven owner in the proper use of metal. Early model microwave ovens failed because of the improper use of metal. Also, because phenolic handles were found on most metal pots and pans being sold, the manufacturers were concerned with legal liability.

Because of the microwave oven manufacturer's tag that read "don't place metal in the oven," myths evolved concerning what would happen when and if metal was placed in the cavity of those tagged ovens. Lets now look at the "myths" of metal in the microwave.

MYTH I - METAL AND ARCING

A myth exists that small electric arcs, within a microwave oven, will somehow, for some reason, destroy something. The basis for this myth is never disclosed.

Normally, small arcs cause no damage to the microwave oven, no damage to the oven power supply and no damage to the metal article that supported the arcs. There are exceptions. Thin metal foil, painted metal surfaces, and metal paints that decorate china and glassware may burn from the arcs caused by microwave energy.

It is easy to create an electric arc in a microwave oven. The arc can be very small or an arc can be large. A large arc appears as a brilliant flash of light and a loud report. Large arcs are uncommon when a "load," e.g. food, is present. Normally the arc that is accidentally caused by the cook is small. These small arcs are comparable to those you experience from your fingertips when a static discharge is released between you and something you touched. For an arc to occur, in a microwave oven cavity, there must exist two electrically conductive surfaces (not necessarily metal surfaces) in close proximity. The arc will then occur, or not occur, depending on size and shape of the surfaces, the distance of the surfaces to each other and the amount of the microwave energy that has not been converted to heat energy in a food within the oven cavity.

A microwave oven does not operate with its door open. With the door closed, an electric arc, inside the oven chamber, caused by a careless or untrained cook, presents no danger to life or limb. Arcing, in the microwave oven chamber between two metal pots and pans, can be prevented through design. Because of proper design, arcing does not occur in the metal of the magnetron, in the metal waveguide, at the metal field stirrer, metal oven cavity or metal oven shelves. Likewise, arcing will not occur in properly designed metal pots and pans. Arcing is easily avoided by a cook trained in the use of metal in the microwave oven.

MYTH II - METAL AND MICROWAVE ENERGY REFLECTED BACK INTO THE MAGNETRON

A magnetron is a device that creates the microwave energy in domestic microwave ovens. Microwave energy is emitted from the metal anode of the magnetron. Microwave energy emitted from the magnetron, follows a metal channel, called a waveguide. The microwaves exit the waveguide into a metal oven cavity. Microwave ovens employ a metal rotating blade, called a field stirrer.

A "load" (e.g. food) converts the microwave energy that penetrates or impinges on its surface to heat. Microwaves will not pass through metal and are reflected off of the surface of metal. Without a "load," the waves of microwave energy bounce continuously off of the metal surfaces that form the oven cavity.

In air, microwaves travel at the speed of light, 186,300 miles per second. In an oven cavity, that is one foot cube, each wave of energy would hit a wall of the oven cavity and be reflected more then 10 BILLION (10,000,000,000) times each second. Microwave energy, not expended as heat in a load, will eventually reflect back up the metal waveguide and heat the magnetron.

Excessive microwave energy "reflected" back to early, "first generation", magnetrons caused them to fail. Operating a microwave oven empty is the surest way of having a large amount of the microwave energy find its way back to the magnetron. Operating a microwave oven, with only a metal covered, metal pot, in its cooking cavity, is equivalent to operating the oven empty.

Microwave oven design technology has advanced. The modern microwave ovens are designed to dispel the heat caused by reflected waves. A modern microwave oven is designed so that if operated empty no damage occurs. The reflection of microwave energy back to the magnetron is the same, from an empty metal utensil in the oven cavity, or from an empty oven. Contrary to myth, the use of metal, in a microwave oven cavity, does not effect either the oven's capability to produce microwave energy or the oven's useful life.

MYTH III - METAL AND MICROWAVE ENERGY REFLECTED AWAY FROM THE FOOD

Another myth, is that food, within a properly designed, metal utensil, will not heat (or not heat, properly) in a microwave oven. Metal's ability, to reflect microwave energy, is not a disadvantage. Metal reflects infrared energy, and this is used to an advantage in gas and electric ovens.

Properly designed, metal pots and pans enable the cook, in gas and electric cooking, to control the cooking results. Reflection or shielding, of infrared energy, from one surface or area of a food, causes a second area to heat faster. Any cook can list the advantages of reflecting energy. One clear demonstration is the insulated, metal cookie tray. The metal cookie tray allows the top surface of the cookie to become browner while the cookie remains moist and soft. The insulated tray further reduces the amount of infrared energy reaching the cookie's bottom.

In conventional gas and electric cooking, the cooking differences between metal and non-metal cookware must be considered. Just as metal utensils direct or focus infrared energy, in conventional cooking, metal utensils can be designed to direct and focus microwave energy. A cook taught to use metal utensils, that are designed to direct or focus microwave energy, in a microwave oven, will achieve the cooking results of gas and electric cooking.

MYTH IV - METAL AND MICROWAVE OVEN EFFICIENCY

The use of metal does not decrease the efficiency of a microwave oven. Neither the power efficiency nor the cooking efficiency, of a microwave oven, is diminished by using a properly-designed, metal-cooking device. When metal is used in conjunction with microwave-lossy heating elements, microwave energy is converted into heat energy as efficiently as it is by an equal mass of water.

The use of metal, in microwave cookware, can enhance cooking efficiency. Metal can be used to shield the by-products of cooking from exposure to microwave energy. If the by-products, of cooking, are shielded, then more microwave energy is available to cook the food.

CONVENTIONAL METAL POTS AND PANS VS. "MICROWAVE SAFE" METAL POTS AND PANS

Before you use the metal pots and pans found in your kitchen for microwave cooking, their shape, design and size must be considered. Metal pots and pans, that do not allow a food, contained therein, to heat should not be used.

It is not dangerous to use properly designed metal pots and pans in a microwave oven. It is dangerous to use conventional metal pots and pans with phenolic handles. Phenolic is a black, plastic material, which has been used, since the early part of this century, as handles for conventional metal pots and pans. Phenolic is not "Microwave Safe." Phenolic plastic handles contain water molecules. When exposed to microwaves, the water molecules heat and the plastic explodes. The explosion does not always occur while in the oven. Often the plastic explodes, without warning, minutes after being exposed to microwave energy. Don't put metal with phenolic handles in your microwave oven!

Metal pots and pans, for microwave cooking, should be tested, as are glass and ceramic. The manufacturers, of metal pots and pans, should stamp the words "Microwave Safe" on the metal utensils designed to be used in microwave cooking.

INFRARED COOKING VS. MICROWAVE COOKING

The objectives, in both conventional cooking and microwave cooking, are identical. The object is to obtain a hot, cooked food with a pleasing appearance, taste, and texture. Economy and retained nutritional value are expected.

Speed of cooking is considered, by many, to be the sole reason to cook by microwaves. Microwave cooking times are faster than conventional cooking times. Properly designed metal, microwave-oven cookware makes microwave cooking faster and so increases the advantage over conventional cooking. Hotter and more palatable food is obtained. Using metal cookware, undesirable spot or edge heating, associated with cooking in paper, glass or plastic, is controlled. Economy and nutrition are still present.

If you desire to fry an egg, in a microwave oven, with a soft liquid yolk, and you desire the results that your gas or electric range provides, you need a metal frying pan and a microwave-lossy, heating element. When properly-designed, metal

cookware is used, in microwave cooking, the cooking results duplicate or are superior to the results expected from conventional gas or electric cooking.

In gas and electric cooking, preheating an oven or preheating a grill and a frying pan is accepted practice. If one wishes to duplicate, in microwave cooking, the cooking results obtained in preheated gas and electric ovens and on preheated grills and frying pans, then preheated "Microwave Safe" metal grills, frying pans and ovens are required.

LEARNING HOW TO USE METAL COOKWARE IN MICROWAVE COOKING

Think of how you learned to use a gas or electric stove. You watched your parents or your grandparents cook. You took a course in school. You learned from a friend or neighbor. As a child you were not allowed to use pots and pans in conventional gas and electric cooking until 1) you knew how, 2) understood hot and cold, and 3) could demonstrate this understanding to your mother.

Cooking, in a microwave oven, requires training and understandings. The successful cook must understand:

1. An average domestic microwave oven can achieve the cooking results of the conventional oven, in less time, and operates on one-tenth the power. In microwave cooking, heat is created as the microwaves excite water molecules within the food. The heat is created both at and below the surface of a food. In contrast, in conventional cooking, infrared heat energy heats only the food's surface. The surface heat must then heat the entire mass of the food.

2. The surface of a food will not brown while it contains moisture. In both infrared and microwave heating, moisture at the surface, of a food, must be driven from the surface before the surface temperature can rise and cause browning.

3. Microwave ovens employ an exhaust fan. The fan is designed to exhaust the moisture, evaporating from a cooking food, from the oven cavity. If this moisture was not exhausted from the oven cavity, it would condense on the cool oven walls and form pools of water on the oven floor. The exhaust fan of the microwave oven, by evaporating moisture from the surface of the food, cools the surface of the food.

4. Covering or enclosing food, cooked within the microwave oven, slows the vaporization of moisture from the foods surface. A container, that contains steam pressure, provides a heat-insulating blanket of steam around the food. This blanket of steam is generated from the hot parts of the cooking food. Contained, steam condenses on the colder parts of the food.

5. A metal container heated by steam condensing on its colder surface, is simultaneously cooled by contact with cold portions of food it contacts. The metal

container exchanges the heat of the steam for the cold of the food. Steam continues to condense on the metal until the temperature of the food, metal, and condensed steam equalize. The steam, not condensed, surrounds the food and prevents the food surface from losing its heat. The steam insulated food surface, unable to lose heat, will rise to its browning temperature.

6. Certain types of ceramic and glass are unsafe in the microwave oven. Certain shapes and designs of metal containers can not be used in microwave ovens.

FAILURE OF EARLY "BROWNING DEVICES" TO PLEASE THE CONSUMER

Several, preheated-by-microwave-energy, glass-ceramic and metal heating grills have been marketed. These utensils employ a surface to contact the food and a material which converts microwave energy to heat energy in thermal contact with the food contacting surface. These "browning grills, "without food, are exposed to microwave energy until they heat to a desired temperature.

The early metal "browning grills" would not heat to a temperature higher then 350-450oF. Food placed on these early metal grills barely browned. The glass-ceramic "browning grills" spot heat to temperatures higher then 1500oF. Food placed on glass-ceramic grills spot burn.

These early "browning devices" performed poorly or unreliably. They were not able to be cleaned in a dishwasher. They required too much storage space. Their plastic parts discolored or cracked for various reasons.

MICROWAVE COOKING REQUIRES PROPERLY DESIGNED METAL COOKING UTENSILS

Properly-designed, metal cookware uses to its advantage metal's ability to reflect both microwave energy and infrared heat energy off of its surface. Metal's special ability, both to shield the bottom portion of a food from direct microwave radiation and to focus microwave radiation on the top crust of a food can be used to advantage. A metal pie plate is useful, in reflecting infrared energy and microwave energy off of its bottom and side surfaces. When using the metal pie plate a large proportion of either the electric oven's infrared energy or the microwave oven's microwave energy must enter the pie through its crust. Because the majority of energy enters the pie through the top crust, the top crust browns. Metal can end the undesirable drying of thin peripheral and end portions of meat.

Metal is more heat conductive then glass, plastic or paper. Food, heated within metal cookware, designed for microwave cooking, will be more evenly heated. Glass breaks and melts, paper chars and burns, and plastic melts and burns. Burning plastic and burning paper emit noxious fumes. Only metal can cook at the browning

temperature required to achieve the browning results expected by the consumer. Microwave oven cooks must be taught the proper use of metal containers.

METAL MAKES A SUPERIOR MICROWAVE COOKING CONTAINER!

Metal conducts heat more efficiently then does glass, plastic or paper.

Metal's ability to reflect microwave energy can be used to limit undesirable "edge heating", "spot heating", "selective heating", and can be used to shield by-products of cooking from further microwave exposure.

Metal can direct and focus microwave energy.

Metal resists thermal shock.

Microwave energy can heat metal to browning temperatures.

A rod of metal will heat or remain cold, when exposed to microwave energy, depending on its length.

Using metal containers, in microwave cooking, adds new flavor to cooking and provides cooking results never before known.

Metal pots and pans are useful in commercial and industrial microwave heating. Food is not the only thing we heat.

Microwave cooking, in metal containers, is the perfect cooking system for the gourmet cook and for the health faddist.

Metal does not break like glass, melt like plastic, or burn like paper.

DUAL UTILITY

What is called for is a completely new set of metal pots and pans specially designed to have utility in both conventional cooking and in microwave cooking. Manufacturing this special metal cookware will create jobs and will require the writing of new cookbooks.

SUMMARY

Metal, pots and pans are as useful in microwave cooking as they are in gas and electric cooking. The need for metal microwave utensils is the opposite of what rumor and myth would have you believe. The proper use of metal microwave

utensils results in more efficient oven operation and longer life for the microwave generating tube. Microwave cooking results, using metal, duplicate conventional gas and electric cooking results.