

Featured Articles

Development of Microwave Oven with Bakery Functions —Adding Healthy Cooking to Environmentally Conscious Features—

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OVERVIEW: As microwave ovens have developed over the years, cooking functions have evolved as a means of satisfying the universal consumer need for “healthiness.” Along with enhancements for healthy cooking functionality in FY2014, recipes for one or two people were added to cooking menus that had previously been designed for three or four people (in the FY2013 model, MRO-MBK5000). Furthermore, the model’s bakery functions, which are unique in the industry, were enhanced while making progress in satisfying the need for shorter cooking times. Energy-saving performance has also been improved through the development of new technologies, including improved efficiency in the microwave control and oven heaters used in microwave ovens.

INTRODUCTION

AS health consciousness has increased due to factors such as the aging of society, the need for microwave ovens that can cook in a healthy fashion is intensifying. Also, although cooking for three or four people has traditionally been the default setting, cooking devices must now respond to changes such as the increase in small households, and the accompanying increase in occasions to cook for fewer people.

Furthermore, factors such as the increase in two-income households have reduced the amount of time available for cooking, thereby intensifying the need for reduced cooking time.

It is based on this background that microwave oven development in FY2014 had been proceeding based on the themes of “enhancing healthy cooking”, “developing and improving the convenience of menus for small households,” “reducing cooking time,” and “improving energy-saving performance.”

The unique steamed grilling function enables healthy cooking by combining a variety of different heat sources. In FY2014, we took advantage of this function in order to realize healthy “fried food” that does not use oil, and for “steamed vegetables” that lose less vitamin C through low-oxygen cooking*1. Furthermore, we developed menus that satisfy the

need for healthy cooking with fermented food by removing excess fat and salt, by frying without oil, and in other ways. We also developed and included new menus for one or two people in order to address the needs of small households, while working to expand the “ten-minute cooking menu” in order to address the need for shorter cooking time.

In addition, we developed microwave transmission loss reduction technology and highly efficient heating technology for use in convection oven heaters as energy-saving technologies.

In FY2012, we launched the only microwave oven in the industry with the added value of a bakery function that can automatically bake bread, including adding ingredients, kneading, fermenting, and finally baking. We are also developing new functionality



Fig. 1—MRO-NBK5000 Microwave Oven with Bakery Function Released in FY2014.

The exterior of the superheated steam microwave oven is shown above. The oven has a bakery function to satisfy the need for home-baked bread and a wide-ranging “Healthy Cooking” menu.

*1 The weight of vitamin C in 100 g of raw broccoli is 88.0 mg, of which 62.9 mg remains after cooking using the “steamed broccoli” menu option, or 50.4 mg in the case of baking (based on Hitachi’s research).

for new products that offer shorter baking time for a single loaf of bread as well as a “healthy bread menu,” in addition to improved convenience and ease of use (see Fig. 1).

This article describes the efforts involved in the development of these unique functions.

ENHANCED HEALTHY MENUS

The “grill plate” and “steam lid” inside the microwave oven are used in a steamed grilling system offered only by Hitachi that cooks by combining the following heat sources: superheated steam, steam, oven heater, microwave, and plate heated by microwave superheated steam, the grill plate underneath (see Fig. 2). This system produces healthy fried food (see Fig. 3) and provides an automated menu that makes it easy to cook recipes with adjustments of heating power and duration.

For the FY2014 product, we sought to enhance the healthy menu by taking advantage of the characteristics of this configuration. By filling the inside of the steam lid with steam, it is possible to rapidly reduce the concentration of oxygen inside the lid (see Fig. 4). This enables cooking under a low oxygen environment,

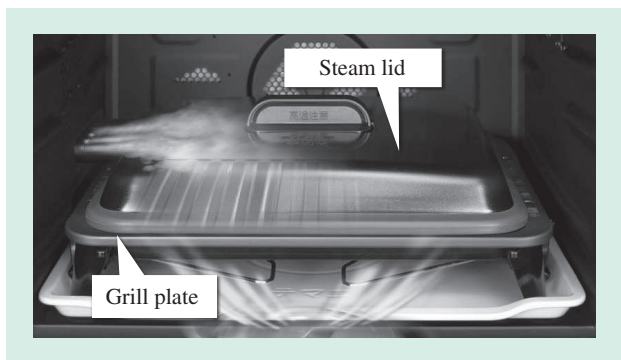


Fig. 2—Steamed Grilling System. This unique cooking method uses a grill plate and a steam lid.

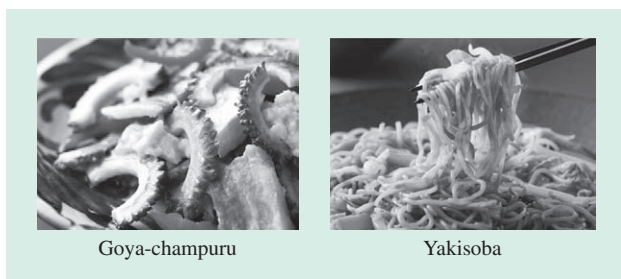


Fig. 3—“Fried Food” without Oil. Goya-champuru, yakisoba, and other dishes can be cooked in a healthy fashion without the need for frying oil.

which prevents oxidation of nutrients such as vitamin C during cooking. A new “steamed vegetables” menu was developed based on this method (see Fig. 5).

We also responded to consumers’ health needs by providing a lavish healthy menu that includes cooking with fermented food, cooking with superheated steam that removes excess fat and salt, “non-fried cooking” that fries without oil, and other options (see Fig. 6), while ensuring that anyone can cook healthy food conveniently.

MENU DEVELOPMENT

Development of Menus for a Smaller Number of People

To design menus that support small households, we revised the heating patterns and heating duration for each heat source based on weight, thereby developing menus for one or two people (see Fig. 7) while also revising the liquid crystal display (LCD) touch panel. The addition of a “Menus for One or Two People” button on the initial screen makes it possible to select menus for a small household from the touch panel

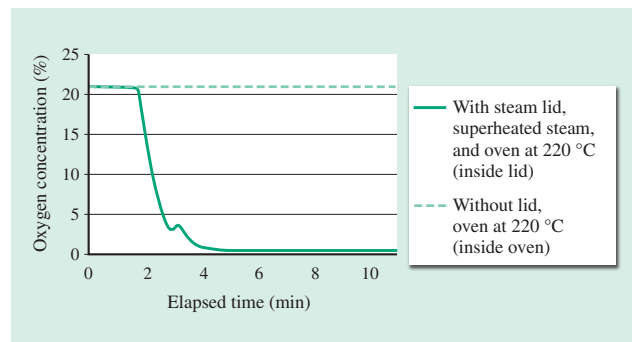


Fig. 4—Changes in Oxygen concentration under the Steam Lid. The oxidation of food items is prevented by filling the steam lid with steam in order to lower the oxygen density.

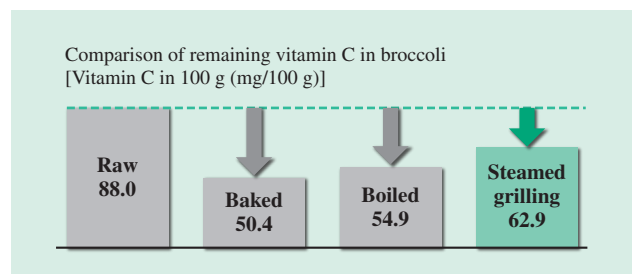


Fig. 5—Comparison of Remaining Vitamin C: Broccoli Cooked Using the “Steamed Vegetables” Menu Option. The “Steamed Vegetables” menu option, which activates the steamed grilling, reduces the loss of vitamin C when compared to baking vegetables using conventional oven heating.

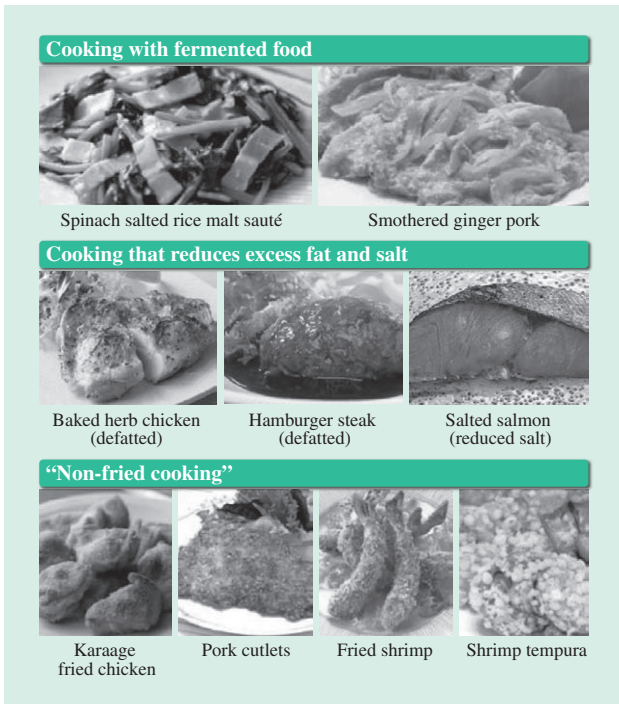


Fig. 6—Wide Range of Healthy Menu Options [161 Healthy Menu Options (MRO-NBK5000)].
Menu options are available for cooking with fermented food and other healthy food items, cooking that reduces excess fat and salt, and healthy “non-fried cooking” that does not use oil.

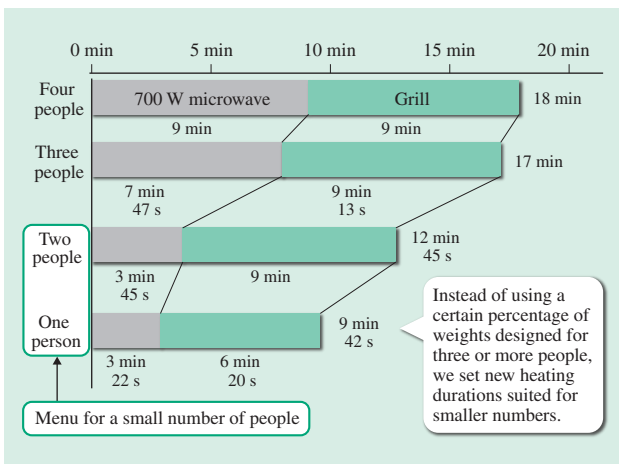


Fig. 7—Number of People and Heating Duration for “Baked Herb Chicken.”
Microwave heating times are adjusted when cooking for three or more people, and grill heating times are adjusted when cooking for fewer people.

without hesitation (see Fig. 8).

The previously adopted “Tips for Skilled Use” display button that shows tips for how to use the oven and the “Show Ingredients” display button that can be used to verify ingredient weights have also been modified to support menus for a smaller number of

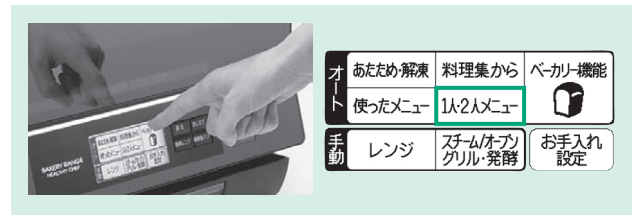


Fig. 8—One or Two People Menu Screen.
The addition of a new button on the initial screen makes it easy for users to select the right menu option without hesitation.

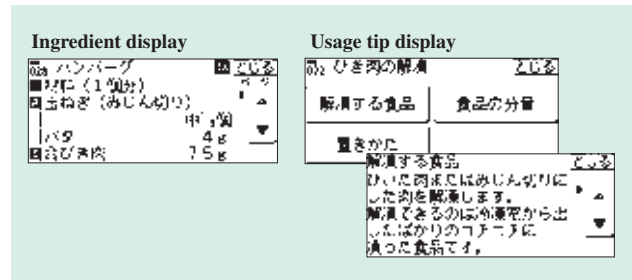


Fig. 9—Ingredient and Usage Tip Display.
Recipe ingredients and usage tips are displayed, thereby enabling cooking without the need to read a cooking guide or manual.



Fig. 10—Ten-Minute Menu Examples.
Lavish menu options that have been prepared in order to satisfy the need for reduced cooking time.

people, and a touch panel can now be used for menu selection (see Fig. 9).

Development of Menus for Shorter Cooking Time

We developed a ten-minute menu in order to respond to the need for reduced cooking time. This menu provides a wide range of dishes, including “smothered miso chicken,” “sautéed tomatoes and kimchi,” “smothered ginger pork,” and others (see Fig. 10).

DEVELOPMENT OF UNIQUE FUNCTIONS

Bakery Function

In FY2012 we released a microwave oven that offered a bakery function that was unique in the industry. Not only could it knead, ferment, and bake

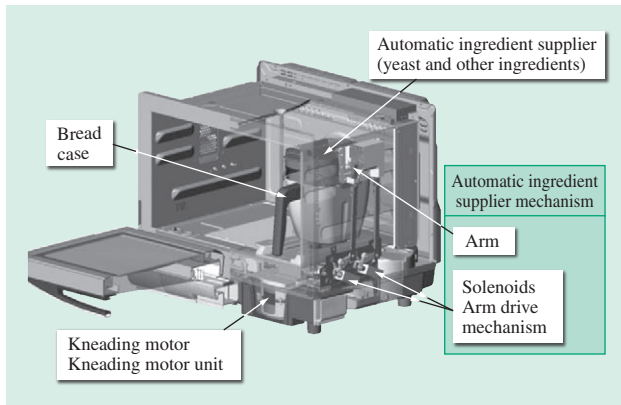


Fig. 11—Bakery Function Framework. Yeast and other ingredients are automatically supplied by the “automatic ingredient supplier.”

bread automatically inside the oven, it also included an industry-first “automatic ingredient supplier” developed by Hitachi that enabled it to automatically add yeast and other ingredients into the bakery case inside the microwave oven (see Fig. 11).

Responding to Needs for Shorter Cooking Times and Healthier Cooking

Based on research we performed at the start of development of the bakery function, it was known that home bakeries that were already commercially available could generally bake a loaf of bread in approximately four hours using the “standard course,” or in approximately two hours using a “quick baking” mode, and so it was evident that reducing the cooking time even further would be an issue. It was at this point that Hitachi started focusing on reducing the time required for the bakery function. The product we released in FY2012 could bake a single loaf of bread in approximately two hours, whereas the FY2013 version reduced that to 100 minutes, while the FY2014 version achieved a baking time of approximately 90 minutes

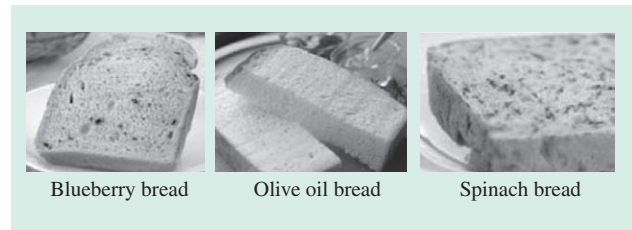


Fig. 13—“Healthy Bread Menu.” Healthy bread can be baked by adding healthy ingredients to the mix.

through stronger kneading, changing the ingredient composition, and increasing the temperature of the baking process (see Fig. 12).

Furthermore, we developed a bakery menu that satisfies the need for healthy options. This healthy menu provides a wide range of newly developed recipes, including “calorie-cutting bread” that is baked deliciously with less butter and other such ingredients using a convection oven technology, “vegetable/fruit bread” with healthy ingredients included in the mix, “olive oil bread,” and others (see Fig. 13).

ENERGY-SAVING TECHNOLOGY

The technologies used for improving energy-saving performance in microwave and oven functions are described below.

Reduced Microwave Transmission Loss

The energy-saving performance of the microwave function is evaluated by heating a specified weight of water (heated load) from 10 ± 1°C to 70°C, while measuring the energy consumption and extrapolating in order to determine the energy consumption equivalent to one year of use. We worked to improve energy-saving performance by developing a new low-loss waveguide to use for microwave heating inside

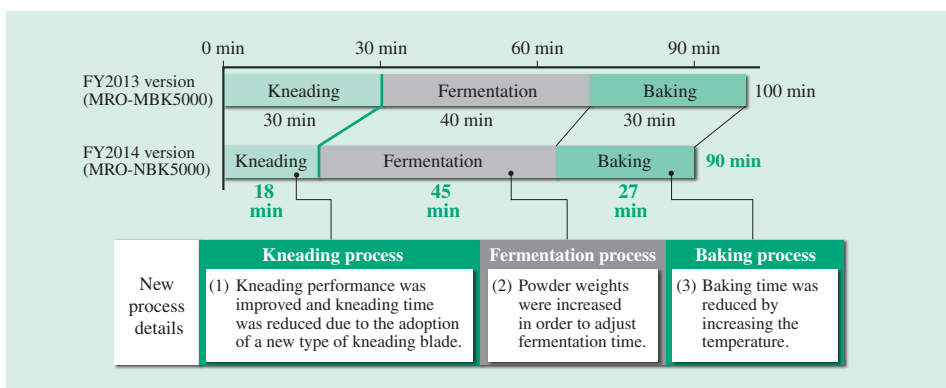


Fig. 12—Bakery Process Chart. Both kneading and baking processes were improved in the FY2014 version of the product, thereby reducing the required time.

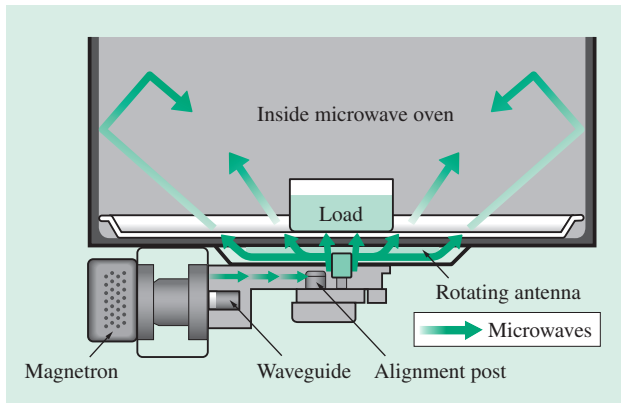


Fig. 14—Microwave Transmission Path.
The structure has been successfully constructed so as to reduce transmission loss.

the oven (see Fig. 14).

Energy-Saving through High-Efficiency Heating with a Convection Oven Heater

The energy-saving performance of the oven function was evaluated by adding the amount of energy consumed while increasing the oven's internal temperature from the initial temperature ($23 \pm 2^\circ\text{C}$) up to 177°C , to the energy consumed by then maintaining this state continuously for 20 minutes, and extrapolating in order to determine the energy consumption equivalent to one year of use. By adding an airflow guide to the back plate of the heating chamber, we constructed an efficient pathway for the heat from the convection oven heater to be transferred

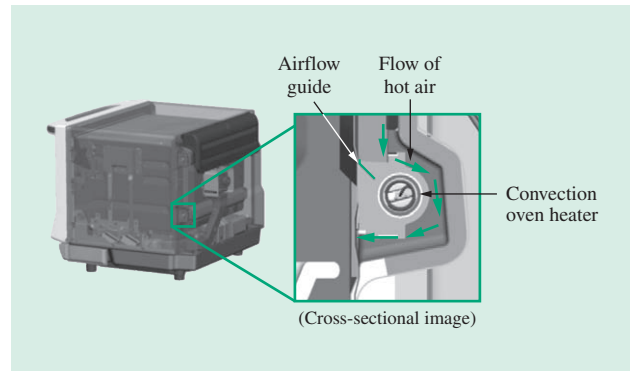


Fig. 15—Structure around Convection Oven Heater.
The structure of the area around the convection oven heater was optimized utilizing thermal fluid simulation in order to improve energy-saving performance.

to the air (see Fig. 15). This reduces the warm-up time of the oven by approximately 60 seconds, and successfully improves energy-saving performance.

CONCLUSIONS

This article described the development of healthy cooking functionality that was achieved utilizing unique technologies, as well as the development of menus designed for smaller numbers of people, reduced cooking times, and energy-saving technologies. In the future, Hitachi will continue working to offer attractive added value in our microwave ovens while remaining closely attuned to changing trends in demand.

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