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(54) **Oven with moisture sensor**

(57) The present invention relates to an oven, such as a microwave oven, a steamer or the like, which is configured to heat and/or cook food. The oven may comprise an oven cavity 5 which may accommodate the food to be heated. Further, a plate 11 may be placed inside the oven cavity 5 for carrying the food. At least one moisture sensor 13 may measure a moisture value of a partial

surface of the food which defines a moisture measuring area. The at least one moisture sensor 13 may be integrated into the plate 11. In order to control an operation of oven a control unit may be provided. The control unit may perform the oven operation based on the measured moisture value respectively moisture values.

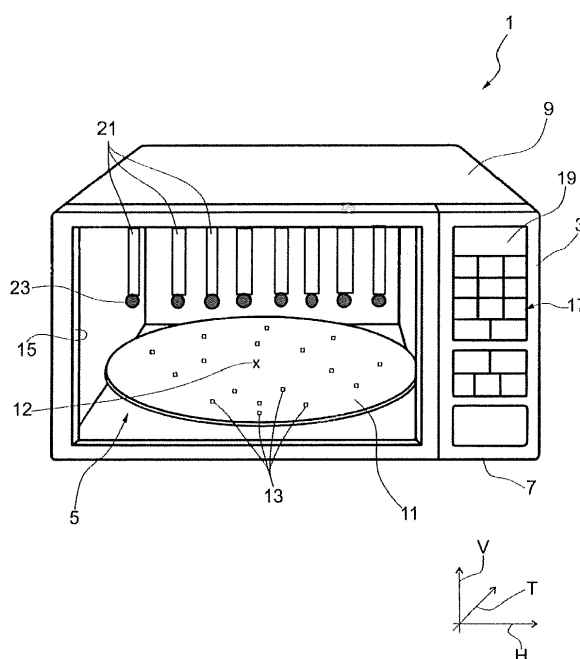


Fig. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to an oven, such as a microwave oven, a steamer or the like, adapted to provide a homogenous heating and/or cooking of food. The invention also relates to a method for homogeneously heating and/or cooking of food by means of an oven.

TECHNICAL BACKGROUND

[0002] It is known from US 2008/0236404 to adapt conventional ovens to have a moisture sensor and a steam injector arranged within an oven cavity in order to establish a method and an apparatus for regulating the cooking process such that a homogeneous heating of food which is placed inside the oven cavity is improved. The cooking process comprises a measuring phase where moisture in the oven cavity is sensed by the moisture sensor and a steam phase where the steam injector introduces steam into the cavity. A fan arranged inside the cavity reduces a concentration of steam/gas or moisture. Although the supply of the oven cavity with steam in general may improve the heating characteristics, and the ventilation may reduce a concentration of the supplied steam, a heterogeneous heating might still be caused due to a heterogeneous moisture distribution within the food. This may result in partly over-cooking or overheating of the food which decreases the food quality.

[0003] From US 5,525,782 a microwave oven is known which is able to detect humidity conditions inside an oven cavity and decide, based on the detected humidity conditions, if food placed inside the oven cavity needs to be humidified or not. A humidity sensor detects the humidity of gas generated by the food within the oven cavity. A control unit controls, in response to receiving the detected humidity value, the amount and temperature of steam to be injected by a steam generator. Also the microwave oven according to US 5,525,782 only provides means or a method for humidifying the oven cavity in general and does not deal with a heterogeneous moisture distribution within the food.

[0004] Therefore, there is a need to provide an oven that addresses the problem of a heterogeneous moisture distribution within the food.

SUMMARY

[0005] It is an object of the present invention to overcome the above-mentioned disadvantages of the state of the art. One aspect of the invention relates to an oven with an improved control of the food heating process. A further aspect relates to a method for improved controlling of the food heating process.

[0006] According to a general aspect of the invention at least one moisture sensor measures a moisture value or content of the food, for example at a surface of the

food or within the food. The heating process of the food by means of an oven may be based on the measured moisture value in order to achieve an improved and homogeneous heating of the food. Further, by measuring the moisture value of different parts or portions of the dry parts or portions of the food product may be detected. based on the measurement(s), the heating process of the food may be controlled and/or measures may be implemented in order to effect a homogeneous moisture distribution of the food. For that purpose, at least one vapor injector may operate closely to the food and selectively vaporize the dry parts or portions of the food.

[0007] In an embodiment of the invention, an oven (e.g. a microwave oven, a steamer or the like) may heat and/or cook a food product. Such food (product) may in general be any kind of food. However, the problem of a heterogeneous moisture distribution within the food usually does not occur in liquids which therefore are not subject to heterogeneous cooking and/or heating. Advantageously, the invention may be applied to food having a high degree of viscosity. The oven may comprise an oven cavity which may accommodate the food to be heated. Further, a plate may be placed inside the oven cavity for carrying the food. At least one moisture sensor may measure a moisture value of a partial surface of the food which defines a moisture measuring area. The at least one moisture sensor may be integrated into the plate. In order to control an operation of oven a control unit may be provided. The control unit may perform the oven operation based on the measured moisture value respectively moisture values.

[0008] In an example embodiment of the invention, at least two moisture sensors may be integrated into the plate. Each moisture sensor may measure a moisture value of a moisture measuring area of the food. In an example embodiment, the moisture measuring areas of adjacent moisture sensors may differ from each other. For example, a first moisture sensor corresponds to a first moisture measuring area and a second moisture sensor corresponds to a second moisture measuring area, wherein the first measuring area differs from the second measuring area. In a further example, the first measuring area and the second measuring area may not overlap with each other. Therefore, different parts or portions of the food may be measured with regards to their moisture content. The moisture values may be used by the control unit to control operation of the oven.

[0009] According to another example embodiment of the invention, the at least two moisture sensors are evenly distributed on the plate with regard to a center of the plate. For example regarding a rotatably supported circular plate, the sensor may define a rotational axis of the plate within the oven cavity. Different shapes of the plate are also possible.

[0010] In a further example embodiment, at least one vapor injector is arranged within the oven cavity. The vapor injector may vaporize a partial surface of the food defining a vaporizing area. The control unit may then re-

quest the at least one measured moisture value from the at least one moisture sensor and, based on the at least one measured moisture value, initiate the at least one vapor injector to vaporize its vaporizing area. Thereby, an automatic regulation and control of the moisture content of the food to be heated may be realized.

[0011] In an example embodiment of the invention, each vaporizing area corresponds to a moisture measuring area. This means that the control unit may assign a vaporizing area to a moisture measuring area and, in response to this assignment, initiate a specific vapor injector relating to a partial surface of the food. In a further example embodiment, in the corresponding vaporizing and moisture measuring areas are diametrically opposed with respect to the food. This means that the vaporizing area is arranged essentially directly vertically above the corresponding moisture measuring area.

[0012] According to another example embodiment of the invention, the control unit may exclusively initiate the at least one vapor injector to vaporize its vaporizing area when the at least one measured moisture value of a corresponding moisture measuring area is lower than a predefined threshold moisture value. Thereby, it may be prevented that the food contains areas of portions which are too dry to ensure a homogeneous heating process.

[0013] In another embodiment of the invention, at least one weight sensor may measure a weight value of the food. However, alternative sensors, for example a tactile sensor, which are able to detect whether food is placed on the plate may be used. The weight sensor may be integrated into the plate. Further, the control unit may exclusively request a moisture value relating to a moisture measuring area where the corresponding weight sensor has detected an input signal. Thus, it is prohibited that moisture values not relating to the food itself are used for controlling operation of the oven. Each measured moisture value shall correspond to a partial surface of the food such that a moisture distribution of the food may be derived.

[0014] In a further example embodiment of the invention, at least two weight sensors are integrated into the plate. A first weight sensor may correspond to a first weight measuring area and a second weight sensor may correspond to a second weight measuring area. For instance, the first weight measuring area differs from the second weight measuring area. The measured weight values are therefore independent from one another.

[0015] According to another example embodiment of the invention, the at least two weight sensors are evenly distributed on the plate with regard to a center of the plate. For example regarding a rotatably supported circular plate, the center may define a rotational axis of the plate within the oven cavity. Different shapes of the plate are also possible. Further, each moisture measuring area may correspond to a weight measuring area. In a further example embodiment, adjacent moisture measuring areas correspond to different weight measuring areas.

[0016] In an example embodiment of the invention, the

control unit may compare the measured moisture values received from the at least two moisture sensors and, based on said comparison, exclusively initiate those vapor injectors to inject vapor onto its vaporizing area corresponding to those moisture measuring areas where the measured moisture value is lower than a predefined threshold moisture value. First, a homogeneous food moisture distribution may be generated. The predefined threshold moisture value may indicate a lower limit until which the heating process may be reliably performed. In an alternative embodiment, instead of a threshold moisture value, a maximum measured moisture value may be used. This means that each measured moisture values is compared with a maximum measured moisture value, which of course must be determined for example by the control unit, and an introduction of vapor depends on a deviation between each measured moisture value and the maximum measured moisture value.

[0017] In a further example embodiment of the invention, an amount of injected vapor by a respective vapor injector is chosen according to a deviation of the corresponding measured moisture value from the predefined threshold moisture value. By selectively adjusting the amount of vapor which has to be added onto a respective vaporizing area, a homogeneous moisture distribution of the food may be realized. This means that some vapor injectors may add the high amount of vapor, other vapor injectors may add a low amount of vapor, and again other vapor injectors may not add vapor at all. As explained above, this depends on the respective deviation from the predefined threshold value. Alternatively, instead of using a predefined threshold moisture value, the maximum measured moisture value may define an upper limit which may be achieved by the remaining moisture measuring areas. Again, the moisture content of a respective moisture measuring area is selectively adjusted.

[0018] In a further example embodiment of the invention, the moisture sensors may comprise needle probes. The needle probes may reach into the food for a certain distance, for example at least 1 mm and at most 100 mm, in order to measure inner moisture values. During a measurement phase, the needle probes may be extended, however, during a heating phase of the oven, the needle probes may be maintained integrated into the plate.

[0019] According to another aspect of the invention, a method for heating and/or cooking of food by means of an oven, such as a microwave oven, a steamer, a cooking range or the like, food may be placed on a plate which may be placed and supported within an oven cavity. At least one moisture value of the food may be measured by at least one moisture sensor which may be integrated into the plate. Further, an operation of the oven may be controlled by a control unit based on the measured moisture value. In an example embodiment, the oven may be configured according to any of above described example embodiments.

[0020] It is noted that the method according to the invention can be defined such that it realizes the oven ac-

according to the described aspects of the invention, and vice versa.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The following detailed description refers to the accompanying drawings. The same reference numbers may be used in different drawings to identify the same or similar elements. In the following description, for purposes of explanation and not limitation, specific details are set forth such as particular structures, functionality, etc. in order to provide a thorough understanding of the various aspects of the claimed invention.

[0022] However, it will be apparent to those skilled in the art having the benefit of the present disclosure that the various aspects of the invention claimed may be practiced in other examples that depart from these specific details. In certain instances, descriptions of well-known devices and methods are omitted so as not to obscure the description of the present invention with unnecessary detail.

Fig. 1 shows a perspective view of an oven according to the invention;

Fig. 2 shows an example method of controlling an operation of an oven;

Fig. 3 shows another example method of controlling an operation of the oven;

Fig. 4 shows another example method of controlling an operation of the oven; and

Fig. 5 shows another example method of controlling an operation of the oven.

DETAILED DESCRIPTION

[0023] In the following detailed description of preferred embodiments of the present invention an oven, such as a microwave oven, a steamer or the like, configured to heat and/or cook food is generally indicated with the reference numeral 1.

[0024] With regards to Fig. 1, the oven 1, in the following for instance configured as a microwave oven, is illustrated in a perspective front view. The microwave oven 1 generally comprises a housing 3 which defines a microwave oven cavity 5 inside the housing 3. The housing 3 may have a cuboid shape with a bottom surface 7 for placing on an underground, such as a table, and a top surface 9 limiting the microwave oven cavity 5 in a vertical direction V. The microwave oven cavity 5 may accommodate food (not shown) to be heated and/or to be cooked. In order to open and close the microwave oven 1, respectively the microwave oven cavity 5, a door 15 may be pivotally mounted at the microwave oven housing 3. Further, a plate 11 may be placed inside the mi-

crowave oven cavity 5 for carrying the food. The plate 11 may be rectangular or, as shown in Fig. 1, circular. The plate may further be designed as a plane, even plate with a low wall thickness, for example in the range of 5 mm to 20 mm. A dimension of the plate 11 in a horizontal direction H and a transverse direction T, being oriented perpendicular with regards to the horizontal direction H, may be dimensioned slightly smaller than a microwave oven cavity 5 in the horizontal respectively transverse direction. In case of a circular plate 11, the plate 11 may define a middle point or center 12 relative to which the plate 11 may be rotatably supported within the microwave oven cavity 5. Normally, the plate 11 is rotated in a microwave oven 1 during the heating process. For example regarding an alternative oven using a rectangular plate, it shall be clear that normally the plate is not rotatably supported within the oven cavity, but stationary mounted. Generally, the microwave oven 1 may have a user interface 17 where a user may start and adjust operation, such as the heating process, of the microwave oven 1.

[0025] Still referring to Fig. 1, at least one moisture sensor 13 is integrated into the plate 11 and may measure a moisture value or content of the food. According to the invention, it is advantageous to directly measure the moisture value of the food, rather than measuring for example moisture content of gas surrounding the food within the microwave oven cavity 5 and afterwards deducing a food moisture value, based on the moisture content of the gas. This leads to a significantly more accurate and efficient way of measuring than in known measuring processes. The moisture sensor 13 may measure a moisture value of a partial surface of the food defining a moisture measuring area. Due to the fact that the moisture sensor 13 is integrated into the plate 11, a measurement may be performed on a partial surface of the food facing the plate 11. In an example embodiment of the invention, the partial surface of the food defining the moisture measuring area is in contact with the plate 11. For example, the partial measuring surface may define an essentially circular, rectangular, or oval shape. The moisture sensor 13 may comprise two sensor probes (not shown) which may come in contact with the moisture measuring area and detect a moisture content of the respective moisture measuring area. For this purpose, a circuit (not shown) may be provided to detect if a current flow is induced between the sensor probes due to moisture content within the moisture measuring area. The intensity of the detected current flow between the sensor probes indicates a moisture content within the moisture measuring area. For example, an increasing detected current flow intensity may be indicative of an increasing moisture content of the food, and vice versa.

[0026] The probes may be spaced apart from each other. In particular, a distance between the probes of a corresponding moisture sensor 13 defines a size of a respective partial measuring surface. In an example embodiment, the probes may only superficially contact the surface of the food. That means that, in this case, the

probes do not reach into the food. Measurement is therefore also superficially performed between the probes on the surface of the food, wherein the induced current flow between the sensor probes is superficially conducted via the moisture measuring area. Conclusively, a local moisture value relating to a partial surface of the food placed on the plate 11 may be measured. As explained further below, in an alternative example embodiment, the moisture sensors may also be configured to measure inner food moisture values.

[0027] The microwave oven 1 one may further comprise a control unit (not shown) which may control an operation of the microwave oven 1 based on the measured moisture value by the moisture sensor 13. For example, the measurement of the moisture content of the food is performed before starting the heating process. This means that, in case of a rotatably supported plate 11, during the measuring phase the plate 11 is stationary with regard to the microwave oven 1, i.e. does not rotate. If the measured moisture value is lower than a predefined moisture threshold value, the microwave oven one may output an audio and/or visual signal indicating that the moisture content of the food is too low, i.e. no ideal and/or homogeneous heating of the food may be realized. This predefined threshold value may be stored on a storage unit (not shown) of the control unit. The threshold value may also be preset by a user using the microwave oven 1 before starting the heating process. Conclusively, the threshold value may be adapted with regard to the kind of food placed in the microwave oven 1. Further measures may be implemented by the control unit.

[0028] Alternatively, the measurements may be performed during the heating process. The control unit may, in response to a measured moisture value being lower than a predefined or preset threshold value, output a warning signal indicative of low moisture content. The control unit may also automatically stop the heating process and ask the user to introduce for example water vapor into the oven cavity 5. The heating process may then be continued if the user restarts operation of the microwave oven 1.

[0029] Again referring to Fig. 1, the microwave oven 1 comprises at least two, for example more than ten, moisture sensors 13. Each of the moisture sensors 13 may measure a moisture value of the food and may be integrated into the plate 11. In an example embodiment, each of the at least two moisture sensors 13 is configured according to the above-described embodiments. This means that each of the at least two moisture sensors 13 directly measures a moisture content of a partial surface of the food, wherein each partial surface defines a moisture measuring area. Therefore, each moisture sensor 13 has a corresponding moisture measuring area. In an example embodiment of the invention, the at least two moisture measuring areas differ from each other. In a further example embodiment, no overlap exists between adjacent moisture measuring areas. Thereby, it is assured that the at least two measured moisture values are

completely independent from each other. Based on the at least two measured moisture values, the control unit may introduce measures for controlling operation of the microwave oven 1, which will be explained in more detail herein below. The size of the moisture measuring areas may depend on the number of moisture sensors 13 integrated into the plate 11. Advantageously, the size of the moisture measuring area and the number of the moisture sensors 13 are adapted with respect to each other such that a surface essentially being equal to the entire surface of the plate 11 may be covered, i.e. may be measured.

[0030] The at least two moisture sensors 13, or at least ten moisture sensors 13 as in Fig. 1, are evenly distributed on the plate 11 with regard to a center 12 of the plate 11. However, the moisture sensors 13 shall be integrated into the plate 11 such that their corresponding moisture measuring areas differ from each other. In case of a circular rotatable plate 11, a rotational axis of the plate 11 may lie in the center 12 of the plate 11. The moisture sensors 13 may then evenly radially and/or circumferentially distributed on the plate 11 with regard to a plate center 12. An example distribution of the moisture sensors 13 on the plate 11 may be described by the equation $y = r * \sin(\varphi)$, wherein r corresponds to a radius of the plate 11 and φ corresponds to a circumferential angle in the range of 0° to 360° . In an alternative embodiment relating to a rectangular plate 11, the moisture sensors 13 are evenly distributed in a width dimension and/or a length dimension on the plate 11. For example, the width dimension corresponds to the horizontal direction H and the length dimension corresponds to the transverse direction T. The evenly distributed moisture sensors 13 deliver moisture values of evenly distributed moisture measuring areas. This allows the control unit to derive conclusions about the moisture distribution of the food. For example, it may be detected which parts or portions of the food dry in which are wet. On this basis, it can be concluded whether the food contains a homogeneous or heterogeneous moisture distribution. Partly overcooking or overheating, i.e. some parts or portions of the food, particularly wetter parts or portions, get heated faster and may therefore be heated too long, may be prevented.

[0031] If the control unit detects a heterogeneous moisture distribution, measures may be introduced by the control unit in order to control operation of the microwave oven 1, as explained above. For example, the control unit may cause an audio and/or visual signal indicating a heterogeneous moisture distribution such that a user has the possibility to counteract, for example add water or water vapor onto the food. In an example embodiment, the control unit may cause a display 19 arranged on a front side of the microwave oven 1 adjacent the user interface 17 to output a visual warning signal. This warning signal may for example include information regarding the position of the moisture measuring area corresponding to the moisture sensor 13 which detected low moisture content. This means that the control unit not only receives the different measured moisture values, but also may

assign each moisture value to a corresponding moisture measuring area which may be assigned to a corresponding moisture sensor 13 which in turn relates to a predefined position on the plate 11.

[0032] In an example embodiment of the invention, adding of vapor onto the food in case of low measured moisture values may be performed by at least one vapor injector 21. As can be seen in Fig. 1, the vapor injectors 21 are arranged within the oven cavity 5 and extend from an inner side of the top surface 9 essentially vertically downwards in the direction of the plate 11, that means in the direction of the food. Each vapor injector 21 may vaporize a partial surface of the food defining a vaporizing area. For example, the vaporizing area may have an essentially circular, rectangular, or oval shape. The size of the vaporizing area may depend on the number of vapor injectors 21 arranged within the oven cavity 5. Advantageously, the size of the vaporizing area and the number of the vapor injectors 21 are adapted with respect to each other such that a surface essentially being equal to the entire surface of the plate 11 may be covered, i.e. may be vaporized. Operation of the control unit may be adapted such that the control unit may request the at least one measured moisture value from the at least one moisture sensor and, based on the at least one measured moisture value, initiate the at least one vapor injector to vaporize its vaporizing area. Conclusively, the control unit detects, based on the measured moisture values, if the food comprises a heterogeneous moisture distribution and may in response introduce measures for controlling operation of the microwave oven 1. For example, the control unit may identify which parts or portions of the food are wet in which a dry. This may be done by assigning each measured moisture value of each moisture sensor 13 to the corresponding moisture measuring area which defines a partial surface of the food. Due to this information, the control unit may initiate specific vapor injectors 21 to introduce vapor onto the food.

[0033] In an example embodiment of the invention, the vapor injectors 21 may comprise a nozzle 23 which protrudes from an inner side of the top surface 9 of the microwave oven 1 such that it is in close proximity of the food in order to vaporize a partial surface of the food which defines a vaporizing area. A smallest distance between the nozzle and the food may be less than 20 cm, 15 cm, 10 cm, or 5 cm. the nozzles 23 may have sensors to measure a distance between the nozzle 23 and the food. Those distance measurements may be used in order to automatically or manually adjust the distance between the nozzle 23 and the food. For instance, a predefined distance may be preset by the user before starting the heating process. For this purpose, the vapor injectors 21 may comprise means which allow the nozzles 23 to move in the vertical direction V, for example in a telescope manner.

[0034] In an example embodiment of the invention, each vaporizing area corresponds to a moisture measuring area. A pair of a corresponding vaporizing area and mois-

ture measuring area may have an identical shape and/or an identical dimension. Conclusively, each vapor injector 21 corresponds to a moisture sensor 13. This allows the control unit to specifically cause those vapor injectors 21 to vaporize its vaporizing area where the moisture value of a corresponding moisture measuring area has detected low moisture content. Heterogeneous food moisture distribution and therefore partly overcooking and/or overheating of the food may be prevented before starting the heating process. In an alternative embodiment, a pair of a corresponding vaporizing and moisture measuring area is diametrically opposed with respect to the food. This means that a corresponding vaporizing area is arranged essentially exactly vertically above the moisture measuring area. Therefore, it is simplified and assured that vapor may be selectively introduced onto the food in order to achieve a homogeneous moisture distribution of the food.

[0035] According to a further example embodiment of the invention, the control unit may exclusively initiate the at least one vapor injector to vaporize its vaporizing area when the at least one measured moisture value of a corresponding moisture measuring area is lower than a predefined threshold moisture value. Instead of a predefined threshold moisture value, which is for example stored on the storage unit of the control unit, a user may preset the threshold moisture value before starting heating and/or cooking. This user input may be received by the control unit by means of the user interface 17. Further, the control unit may exclusively initiate the at least one vapor injector 21 to vaporize its vaporizing area when a difference between the predefined threshold moisture value and the at least one measured moisture value is lower than a predefined tolerance value. This means that vapor is only introduced by the vapor injectors 21 if the difference between predefined or preset threshold value exceeds a predefined tolerance value. This may be advantageous because slight deviations from the threshold value may have no negative effect on the heating and/or cooking process, such that heating may be started without any delay caused by a potential vaporizing process.

[0036] In another example embodiment of the invention, at least one weight sensor (not shown) may be integrated into the plate 11. Such a weight sensor may measure a weight value of the food placed on the plate 11. Alternatively, at least one tactile sensor (not shown) configured to determine if food is placed on the plate 11 may be integrated into the plate 11. Further sensors are also possible. However, the sensors must be able to indicate to the control unit at which position of the plate 11 food is placed. Based on this information, the control unit may derive which of the moisture sensors 13 would deliver a moisture value of the food and which of the moisture values 13 would deliver a moisture value not relating to the food. The control unit may exclusively request a moisture value relating to a moisture measuring area where the corresponding weight sensor has detected an input signal, such as a signal differing from "0" or a default

value. Therefore, the control unit may be prevented from requesting moisture values from moisture sensors which are not in contact with the food which would lead to a falsified moisture distribution. Thus, the weight sensors may make the controlling of the operation of the microwave oven 1 more reliable and more effective. In an example embodiment, the control unit in general may initiate a measurement of a moisture sensor 13. Additionally, the control unit may in general exclusively initiate a measurement of a moisture sensor 13 at a corresponding moisture measurement area where the weight sensor has detected an input signal.

[0037] According to a further example embodiment of the invention, at least two weight sensors may be integrated into the plate 11. Each weight sensor may be configured as explained above. Further, each weight sensor corresponds to a weight measuring area or portion of the food, wherein in an example embodiment weight measuring areas of adjacent weight sensors differ from each other. For example, a first weight sensor corresponds to a first weight measuring area and a second weight sensor corresponds to a second weight measuring area, wherein the first weight measuring area differs from the second weight measuring area. In a further example embodiment, no overlap exists between adjacent weight measuring areas. Thereby, it is assured that the at least two measured weight values are completely independent from each other. Based on the at least two measured weight values in combination with the at least two measured moisture values, the control unit may introduce measures for controlling operation of the microwave oven 1, which will be explained in more detail herein below.

[0038] The at least two weight sensors may be evenly distributed on the plate 11 with regard to a center 12 of the plate 11. However, the weight sensors shall be integrated into the plate 11 such that their corresponding weight measuring areas differ from each other. In case of a circular rotatable plate 11, a rotational axis of the plate 11 may lie in the center 12 of the plate 11. The weight sensor may then be evenly radially and/or circumferentially distributed on the plate 11 with regard to a plate center 12. An example distribution of the weight sensor on the plate 11 may be described by the equation $y = r * \sin(\varphi)$, wherein r corresponds to a radius of the plate 11 and φ corresponds to a circumferential angle in the range of 0° to 360° . In an alternative embodiment relating to a rectangular plate 11, the weight sensors are evenly distributed in a width dimension and/or a length dimension on the plate 11. For example, the width dimension corresponds to the horizontal direction H and the length dimension corresponds to the transverse direction T. The evenly distributed weight sensors deliver weight values of evenly distributed weight measuring areas. This allows the control unit to derive conclusions about position of the food on the plate 11. In combination with the moisture sensors 13 according to which the control unit may detect which parts or portions of the food dry in which are wet, operation of the microwave oven 1

may be controlled more efficient and more precise. On the basis of the moisture values, the control unit may conclude whether the food contains a homogeneous or heterogeneous moisture distribution. On the basis of the weight sensors, the control unit may conclude at which positions on the plate 11 the food is placed, thereby assuring that the control unit only requests those moisture values relating to the food. A reliable and efficient way of controlling an operation of the microwave oven 1 may be provided. As a conclusion, partly overcooking or overheating, i.e. some parts or portions of the food, particularly wetter parts or portions, get heated faster and may therefore be heated too long, may be prevented. If the control unit detects a heterogeneous moisture distribution, measures may be introduced by the control unit in order to control operation of the microwave oven 1, as explained above. This means that the control unit not only receives the different measured moisture values, but also may assign each moisture value to a corresponding moisture measuring area which may be assigned to a corresponding moisture sensor 13 which in turn relates to a predefined position on the plate 11, while assuring that only food related moisture values are requested.

[0039] In an example embodiment of the invention, the control unit may compare the measured moisture values and, based on said comparison, exclusively initiate those vapor injectors 21 to inject vapor onto its vaporizing area corresponding to those moisture measuring areas where the measured moisture value is lower than a predefined threshold moisture value. This leads to the advantage of selectively adding water vapor only onto the dry portions or areas of the food. In an example embodiment of the invention, the control unit may exclusively initiate those vapor injectors 21 to inject vapor onto its vaporizing area corresponding to those moisture measuring areas where a difference between the predefined threshold moisture value and the measured moisture value is lower than a predefined tolerance value. In a further example embodiment, instead of a predefined threshold moisture value, a maximum measured moisture value may be detected by the control unit and vapor is conclusively injected to does vaporizing area is where the corresponding measured moisture value is lower than the measured maximum moisture value. A homogeneous moisture distribution may thereby be achieved or generated.

[0040] According to an example embodiment, an amount of injected vapor by a respective vapor injector 21 is chosen according to a deviation of the corresponding measured moisture value from the predefined threshold moisture value. For example, the control unit adjusts the amount of added vapor. Due to the fact that the amount of vapor introduced by each vapor injector 21 is chosen in accordance to the corresponding deviation of the measured moisture value from the threshold value, each vapor injector 21 is independently controlled in order to generate a homogeneous food moisture distribution. It is clear that the moisture measuring areas having a moisture value higher than the threshold moisture value

are not vaporized, i.e. the control unit does not initiate the corresponding vapor injectors 21 to add vapor onto their vaporizing areas. In another embodiment, the amount of added vapor is based on a deviation of each measured moisture value from a maximum measured moisture value. This operation control variant may even lead to a more homogeneous distribution as the moisture contents of each moisture measuring area are aligned with respect to each other. In a further example embodiment, the vapor injectors 21 may work at the same time to provide a time efficient control method. However, it may also be advantages to successively cause the vapor injectors 21 to vaporize their vaporizing areas such that any potential interference between adjacent vapor streams is prevented.

[0041] In another embodiment of the invention, the moisture sensors may reach into the food such that they are able to measure inner moisture values of the food. The moisture sensors may therefore comprise needle probes (not shown) which may reach at least 1 mm and/or at most 100 mm, in particular at least 3 mm and/or at most 90 mm, in particular at least 5 mm and/or at most 80 mm, in particular at least 8 mm and/or at most 70 mm, in particular at least 10 mm and/or at most 60 mm, in particular at least 10 mm and/or at most 50 mm, in particular at least 10 mm and/or at most 40 mm, in particular at least 10 mm and/or at most 30 mm, in particular at least 10 mm and/or at most 20 mm, into the food. According to this embodiment, it is even possible to measure or detect a moisture distribution within the food, rather than a moisture distribution relating to a surface, i.e. an outer surface, of the food.

[0042] During measurement, the needle probes may be extended in order to get in contact with the food, wherein during the heating process of the food, the needle probes may be maintained integrated into the plate 11. For this purpose, the moisture sensor may comprise a joint which may be continuously elongated and/or shortened in a telescope-manner. Therefore, a distance along which the needle probe reaches into the food may be adapted with regard to the type and size of the food. This configuration allows for a space-saving and easy to implement solution for measuring inner food moisture contents. Also, if food is placed on the plate 11 which is not completely even, i.e. comprises food parts or portions not contacting the plate 11, the needle probes allow measurements even at those parts or portions simply by elongating the hinge in order to extend the needle probes which may then come in contact with a surface of a food part or even may reach into the food so as to measure inner moisture content. Operation of the hinge and the needle probes may be controlled by the control unit. Additionally, the needle probes may comprise for example infrared sensors, or the like, facing the food which are able to detect a distance between the plate 11, and/or the needle probe, and the food. The control unit may then, in response to distance value inputs received from the infrared sensors initiate the hinge to elongate so as

to cause the needle probes to extend in the direction of the in order to contact a surface of the food or even reach in to the food.

[0043] According to another aspect of the invention, a method for heating and/or cooking of food by means of an oven 1, such as a microwave oven, a steamer, a cooking range or the like, food may be placed on a plate 11 which may be placed and supported within an oven cavity 5. At least one moisture value of the food may be measured by at least one moisture sensor 13 which may be integrated into the plate 11. Further, an operation of the oven 1 may be controlled by a control unit (not shown) based on the measured moisture value. In an example embodiment, the oven 1 may be configured according to any of above described example embodiments. It is noted that the method according to the invention can be defined such that it realizes the oven 1 according to the described aspects of the invention, and vice versa.

[0044] With regards to Figs. 2 to 5, exemplary embodiments of the method for controlling an operation of an oven, such as a microwave oven, a steamer or the like, are illustrated. Generally, the method relates to measuring a moisture value or content of the food, for example at a surface of the food or within the food, such that the food heating process by means of an oven may be based on the measured moisture value in order to achieve an improved and homogeneous heating of the food. According to a first example embodiment of the invention, as illustrated in Fig. 2, a moisture value of the food, i.e. a moisture value of a surface of the food or a moisture value within the food, is measured by means of the moisture sensor 13 integrated into the plate 11. Then, the measured moisture value is compared with a predefined threshold moisture value. This step may be done by the control unit. Then, it is checked whether the measured moisture value is smaller than the predefined threshold moisture value. If it is not the case, i.e. the measured moisture value is higher than the predefined threshold moisture value, the heating process of the food by means of the oven may be started. Otherwise, a water steam is directed onto the food in order to vaporize the. Finally, in order to close an iteration loop, again a moisture value of the food is measured by means of the moisture sensor 13 and the method is performed analogously to above-described method steps.

[0045] With reference to Fig. 3, an alternative method of controlling an operation of an oven according to the invention is shown, which essentially only differentiates from the embodiment according to Fig. 2 in that a further condition must be fulfilled in order to cause injection of a water steam. Firstly, a moisture value of the food is measured by means of the moisture sensor 13 integrated into the plate 11 arranged within the oven cavity 5 of the oven 1. Analogously to the embodiment according to Fig. 2, the measured moisture value is compared with a predefined threshold moisture value. Then, if the measured moisture value is higher than the predefined moisture value, the heating process of the food may be started.

Otherwise, it is checked whether the difference between the predefined threshold moisture value and the measured moisture value is lower than a tolerance value. If yes, the heating process may be started. Otherwise, a water steam may be injected into the direction of the food in order to vaporize the food surface. Then, analogously to the embodiment of Fig. 2, an iteration loop is closed such that the measuring of the moisture value may be started again.

[0046] Figs. 4 and 5 in general relate to an alternative embodiment of a method for controlling operation of an oven according to the invention. According to this example embodiment of the method, by measuring the moisture value of different parts or portions of the food dry parts or portions may be detected and, based on the measurements, firstly, the heating process of the food may be controlled and, secondly, measures may be implemented in order to effect a homogeneous moisture distribution of the food. For that purpose, selectively vaporizing of dry parts or portions of the food may be initiated. In comparison to the embodiments of Figs. 2 and 3, several moisture sensors 13, i.e. at least two, are integrated into the plate 11 which is arranged inside the oven 1. Then, firstly, each moisture sensor 13 measures a moisture value of the food, respectively of a surface of the food or a moisture value relating to the inside of the food. Then, the measured moisture values are compared with each other. A sequence sorted according to the size of the moisture values may be built. Then, a maximum moisture value of the measured moisture values is determined and, based on this maximum measured moisture value, a difference may be calculated between the maximum moisture value and each of the other moisture values. Then, for each of the calculated differences, it is checked whether the difference is higher than a tolerance value. If this condition is not fulfilled for any of the measured moisture values, the heating process may be started. Otherwise, an injection of a water steam directed to the food may be introduced. However, steam is only added to those portions or areas of the food where above condition is fulfilled. Finally, an iteration loop is closed and the method starts again with measuring the food moisture values.

[0047] In another example embodiment of the invention, which is illustrated in Fig. 5, firstly, food moisture values are measured by means of the moisture sensors 13 integrated into the plate 11 which is arranged within the oven cavity 5 of the oven 1. Afterwards, each of the moisture values is compared with a predefined threshold moisture value. Then, it is checked for each of the measured moisture values whether the respective measured moisture value is bigger than the predefined threshold moisture value. If this condition is not fulfilled for any of the measured moisture values, the heating process may be started. Otherwise, an injection of a water steam directed to the food may be initiated. However, steam is only added to those portions or areas of the food where above condition is fulfilled. In order to close an iteration

loop, as already explained with regards to Fig. 4, the method starts again with measuring food moisture values.

[0048] Again referring to Figs. 2 to 5, it shall be clear that any additional features which were explained with regards to an oven 1 according to the invention, as illustrated in Fig. 1, may be introduced such that the method may perform steps according to those features. For instance, the injection of the water steam is performed by a water injector, which is for example arranged on an inner side of the top surface 9 of the oven 1.

[0049] The features disclosed in the above description, the figures and the claims may be significant for the realization of the invention in its different embodiments individually as in any combination.

REFERENCE SIGN LIST

[0050]

1	oven
3	housing
5	oven cavity 5
7	bottom surface
9	top surface 9
11	plate 11
12	center
13	moisture sensor
15	door
17	user interface
19	display
21	vapor injector
23	nozzle
V	vertical direction
H	horizontal direction
T	transverse direction

Claims

1. An oven, such as a microwave oven, a steamer or the like, configured to heat and/or cook food, comprising:

an oven cavity (5) to accommodate food to be heated;
a plate (11) placable inside the oven cavity (5) for carrying the food;
at least one moisture sensor (13) configured to measure a moisture value of a partial surface of the food defining a moisture measuring area is integrated into the plate (11); and
a control unit configured to control an operation of the oven based on the measured moisture value.

2. The oven according to claim 1, wherein at least two

- moisture sensors (13), each configured to measure a moisture value of the food, are integrated into the plate (11), wherein a first moisture sensor (13) corresponds to a first moisture measuring area and a second moisture sensor (13) corresponds to a second moisture measuring area, wherein the first measuring area differs from the second measuring area.
3. The oven according to claim 2, wherein the at least two moisture sensors (13) are evenly distributed on the plate (11) with regard to a center of the plate (11).
 4. The oven according to any of the preceding claims, wherein at least one vapor injector (21) is arranged within the oven cavity (5) and configured to vaporize a partial surface of the food defining a vapping area, wherein the control unit is configured to request the at least one measured moisture value from the at least one moisture sensor (13) and, based on the at least one measured moisture value, initiate the at least one vapor injector (21) to vaporize its vapping area.
 5. The oven according to claim 4, wherein each vapping area corresponds to a moisture measuring area, wherein corresponding vapping and moisture measuring areas are diametrically opposed with respect to the food.
 6. The oven according to any of claims 4 or 5, wherein the control unit exclusively initiates the at least one vapor injector (21) to vaporize its vapping area when the at least one measured moisture value of a corresponding moisture measuring area is lower than a predefined threshold moisture value.
 7. The oven according to any of the preceding claims, wherein at least one weight sensor configured to measure a weight value of the food is integrated into the plate (11), wherein the control unit is configured to exclusively request a moisture value relating to a moisture measuring area where the corresponding weight sensor has detected an input signal.
 8. The oven according to claim 7, wherein at least two weight sensors are integrated into the plate (11), wherein a first weight sensor corresponds to a first weight measuring area at the food and a second weight sensor corresponds to a second weight measuring area at the food, wherein the first weight measuring area differs from the second weight measuring area.
 9. The oven according to claim 8, wherein the at least two weight sensors are evenly distributed on the plate (15) with regard to a center of the plate (12), wherein each moisture measuring area corresponds
- to a weight measuring area, wherein adjacent moisture measuring areas correspond to different weight measuring areas.
10. The oven according to any of claims 4 to 9, wherein the control unit is further configured to compare the measured moisture values and to, based on said comparison, exclusively initiate those vapor injectors (21) to inject vapor onto its vapping area corresponding to those moisture measuring areas where the measured moisture value is lower than a predefined threshold moisture value and/or a maximum measured moisture value.
 11. The oven according to any of claims 4 to 10, wherein an amount of injected vapor by a respective vapor injector (21) is chosen according to a deviation of the corresponding measured moisture value from the predefined threshold moisture value and/or maximum measured moisture value.
 12. The oven according to any of the preceding claims, wherein the moisture sensors (13) comprise at least one needle probe configured to reach into the food in order to measure an inner moisture value of the food.
 13. The oven according to claim 12, wherein the moisture sensors (13) comprise a joint configured to be continuously elongated and/or shortened in a telescope-manner so as to cause extension and/or contraction of said needle probe.
 14. A method for heating and/or cooking of food by means of an oven, such as a microwave oven, a steamer, a cooking range or the like, wherein:
 - food is placed on a plate (11) placable within an oven cavity (5); and
 - at least one moisture value of the food is measured by at least one moisture sensor (13) integrated into the plate (11); and
 - an operation of the oven is controlled by a control unit based on the measured moisture value.
 15. The method according to claim 14, wherein the oven is configured according to any of claims 1 to 13.

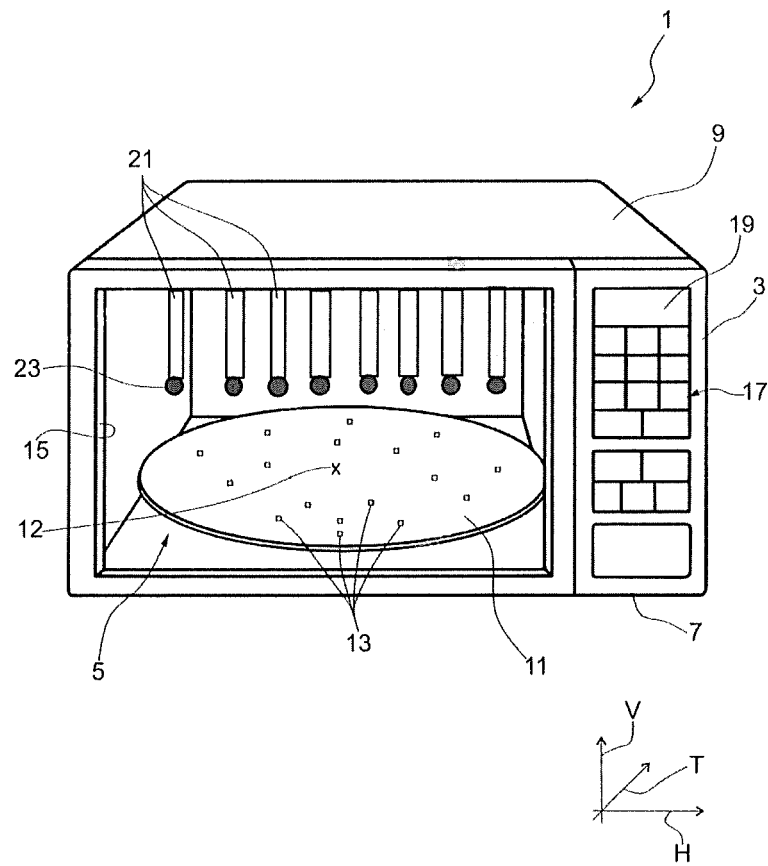
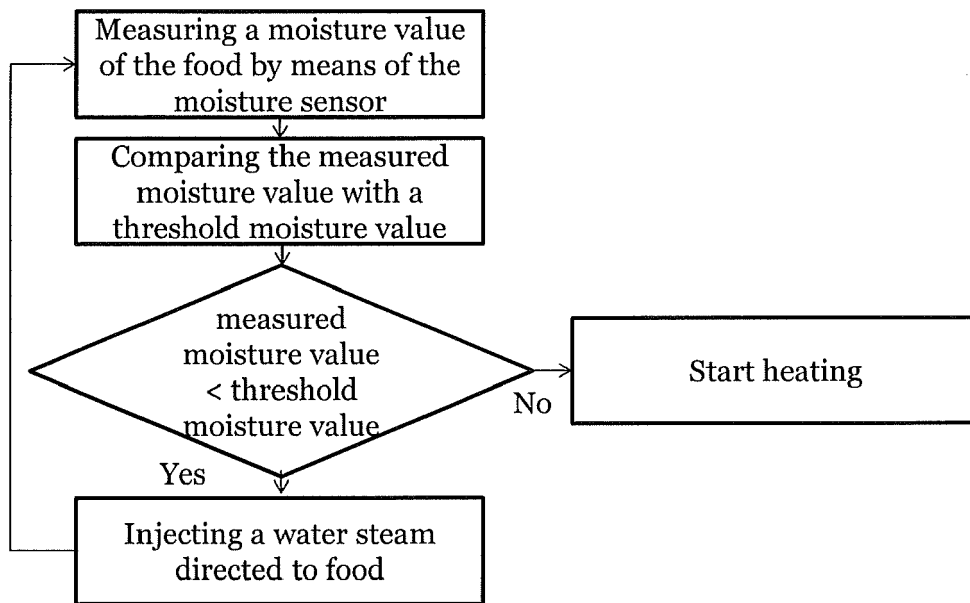
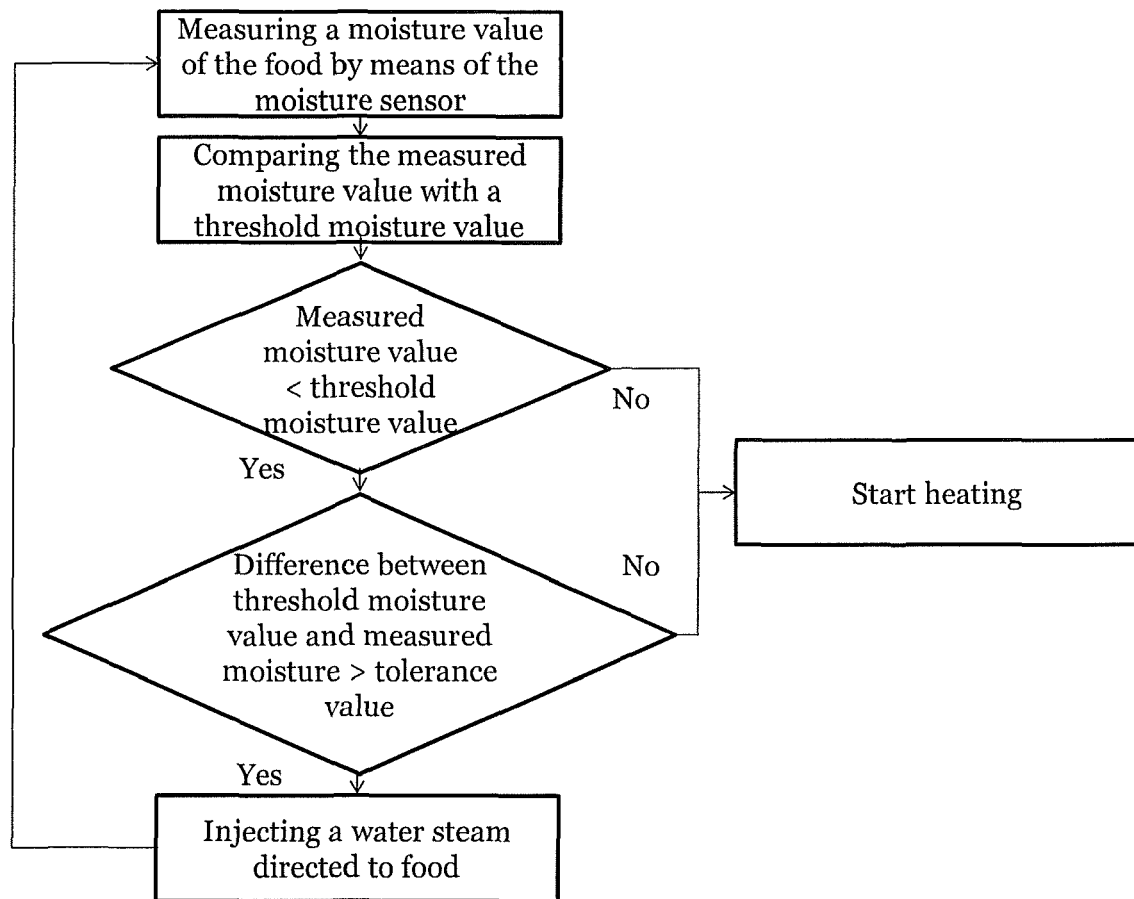
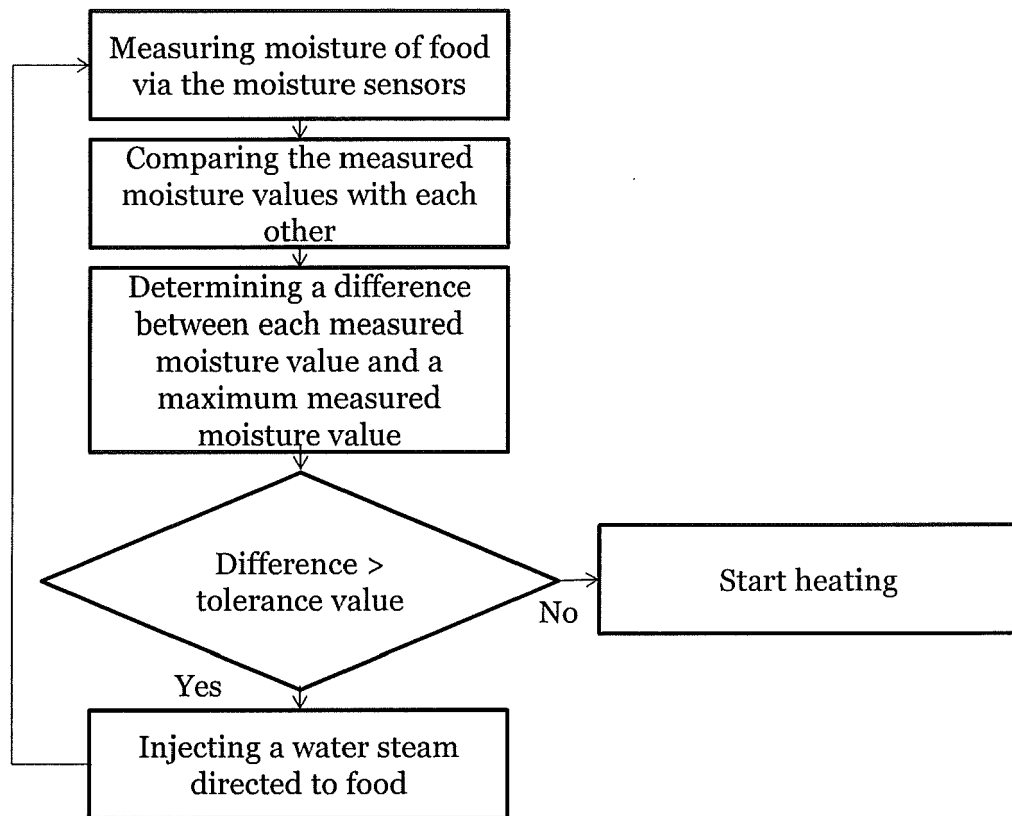
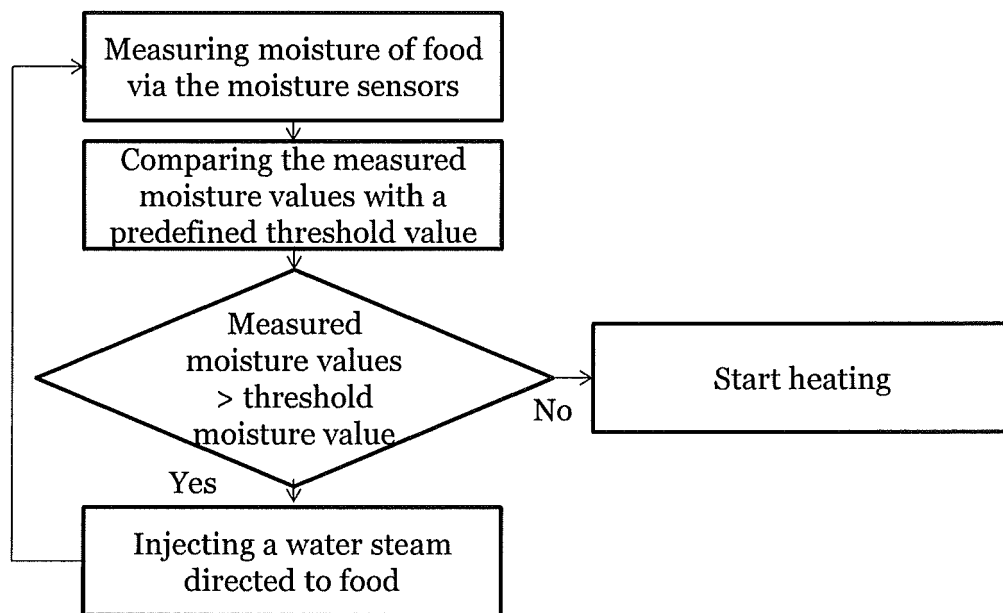


Fig. 1

**Fig. 2**

**Fig. 3**

**Fig. 4**

**Fig. 5**



EUROPEAN SEARCH REPORT

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