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(54) **TOBACCO FILLING MATERIAL, NON-COMBUSTION HEATING-TYPE FLAVOR INHALER, AND METHOD FOR PRODUCING TOBACCO FILLING MATERIAL**

(57) This tobacco filling material comprises: a tobacco material; and at least 0.25 mass% of an antioxidant with respect to the amount of the tobacco material.

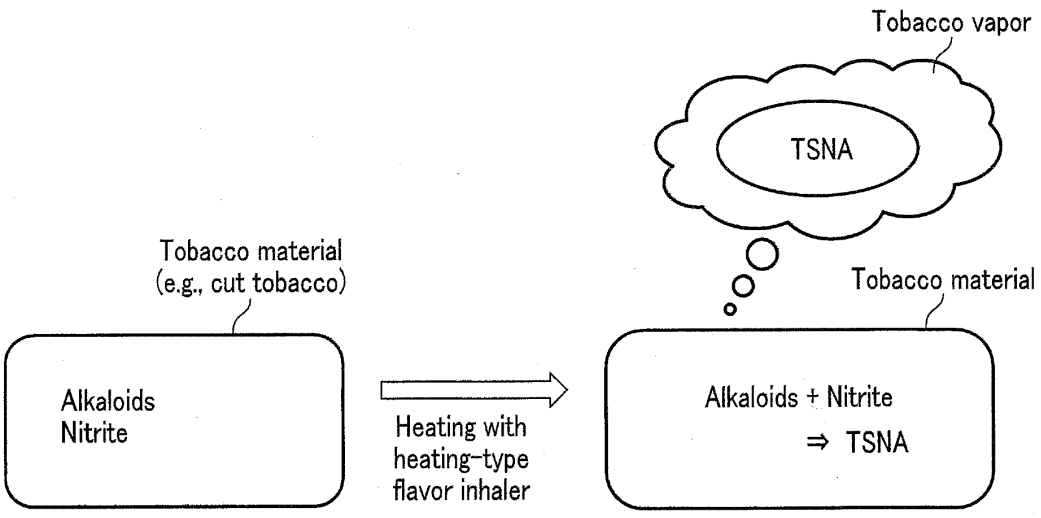

FIG. 1

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Description

FIELD

[0001] The present invention relates to a tobacco filler, a heat-not-burn-type flavor inhaler, and a method for producing a tobacco filler.

BACKGROUND

[0002] Nitrosamine specifically present in a tobacco filler such as leaf tobacco or in cigarette smoke is called tobacco-specific nitrosamine (hereinafter also referred to as "TSNA"). TSNA refers to four components, which are 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), N'-nitrosonomicotine (NNN), N'-nitrosoanatabine (NAT), and N'-nitrosoanabasine (NAB).

[0003] No TSNA is detected in the leaves of tobacco plants before drying. TSNA is generated by nitrosation of alkaloids contained in the leaves of tobacco plants during drying and fermentation of the leaves of tobacco plants and is accumulated in the leaf tobacco.

[0004] It has been reported that TSNA contained in cigarette smoke is generated via three routes (Non-Patent Literature 1 to 3). Specifically, the three routes are a route in which TSNA contained in a tobacco filler is transferred directly to the smoke through evaporation, a route in which TSNA is synthesized by nitrosating alkaloids contained in a tobacco filler by utilizing heat during combustion, and a route in which NNK bonded to a lignin-like polymer component is dissociated and transferred to the smoke.

[0005] On the other hand, it has been reported that TSNA is also contained in a tobacco vapor of a flavor inhaler that heats a tobacco filler without burning it (i.e., a heat-not-burn-type flavor inhaler) (Non-Patent Literature 4).

CITATION LIST

NON PATENT LITERATURE

[0006]

Non-Patent Literature 1: Hoffmann D. et al., "Origin in tobacco smoke of N'-nitrosonomicotine, a tobacco-specific carcinogen: Brief Communication", J. Natl. Cancer Inst., Vol. 58(6), pp. 1841-1844, 1977

Non-Patent Literature 2: Adams J. D. et al., "On the formation of the tobacco-specific carcinogen 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone during smoking", Cancer Lett., Vol. 17(3), pp. 339-346, 1983

Non-Patent Literature 3: Lipowicz P. J. and Seeman J. I., "A model to estimate the sources of tobacco-specific nitrosamines in cigarette smoke", Chem. Res. Toxicol., Vol. 30(8), pp. 1556-1561, 2017

Non-Patent Literature 4: Jaccard G. et al., "Investigation and comparison of the transfer of TSNA from tobacco to cigarette mainstream smoke and to the aerosol of a heated tobacco product, THS2.2", Reg. Toxicol. Pharmacol., Vol. 97, pp. 103-109, 2018

SUMMARY

TECHNICAL PROBLEM

[0007] The inventors of the present invention have worked to reduce the amount of TSNA contained in a tobacco vapor of a heat-not-burn-type flavor inhaler (hereinafter also referred to as a "heating-type flavor inhaler"). When the inventors isothermally heated burley cut tobacco at a temperature corresponding to the heating temperature of the heating-type flavor inhaler (i.e., a predetermined temperature in a range of 150 to 350 °C), there was a tendency for the amount of TSNA contained in the tobacco vapor to increase and the amount of TSNA contained in the cut tobacco after heating to decrease as the heating temperature was increased. At any of the heating temperatures, the total amount of TSNA in the tobacco vapor and TSNA in the cut tobacco after heating was larger than the amount of TSNA contained in the cut tobacco before heating. This means that alkaloids and nitrite reacted with each other in the cut tobacco during heating of the cut tobacco and that TSNA was newly generated (see FIG. 1).

[0008] From the foregoing, the inventors thought that the amount of TSNA in the tobacco vapor can be reduced by suppressing the reaction of generating TSNA that occurs during heating with the heating-type flavor inhaler. However, suppressing the reaction of generating TSNA by performing, in advance, an additional reaction step to remove the substrate (alkaloids and nitrite) of the reaction of generating TSNA not only makes the process complicated but also causes a concern that the additional reaction step will affect the smoking flavor.

[0009] Therefore, an object of the present invention is to provide a technique relating to a tobacco filler which makes it possible to reduce the amount of TSNA in a tobacco vapor of a heating-type flavor inhaler without performing an additional reaction step in the tobacco filler before incorporating the tobacco filler into the heating-type flavor inhaler.

SOLUTION TO PROBLEM

[0010] When the inventors of the present invention prepared a tobacco filler by adding an antioxidant to a tobacco material, nitrite in the tobacco material and the antioxidant reacted with each other during heating with a heating-type flavor inhaler, whereby the inventors succeeded in suppressing the reaction of generating TSNA and completed the present invention (see FIG. 2).

[0011] According to the first aspect, there is provided a tobacco filler comprising:

a tobacco material; and
an antioxidant in an amount of 0.25% by mass or more with respect to the tobacco material.

[0012] According to the second aspect, there is provided a heat-not-burn-type flavor inhaler comprising a flavor source including the tobacco filler according to the first aspect.

[0013] According to the third aspect, there is provided a method for producing a tobacco filler, the method comprising:

adding an antioxidant and a liquid to a tobacco material to prepare a tobacco mixture; and
drying the tobacco mixture to prepare a tobacco filler; and
maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the tobacco material until incorporation of the tobacco filler into a heat-not-burn-type flavor inhaler is completed.

[0014] According to the fourth aspect, there is provided a tobacco filler obtainable by the method according to the third aspect.

[0015] According to the fifth aspect, there is provided a heat-not-burn-type flavor inhaler comprising a flavor source including the tobacco filler according to the fourth aspect.

ADVANTAGEOUS EFFECTS OF INVENTION

[0016] According to the present invention, there is provided a technique relating to a tobacco filler which makes it possible to reduce the amount of TSNA in a tobacco vapor of a heating-type flavor inhaler without performing an additional reaction step in the tobacco filler before incorporating the tobacco filler into the heating-type flavor inhaler.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a schematic view showing that TSNA is generated by heating a tobacco material.
FIG. 2 is a schematic view showing that a reaction of generating TSNA is suppressed by adding an antioxidant to a tobacco material.
FIG. 3 is a flowchart showing an example of a method for producing a tobacco filler in the form of cut tobacco.
FIG. 4 is a flowchart showing a method for producing a tobacco filler in the form of paper-processed sheet tobacco.
FIG. 5 is a flowchart showing a method for producing a tobacco filler in the form of slurry-processed sheet tobacco.
FIG. 6 is a flowchart showing a method for producing a tobacco filler in the form of tobacco granules.
FIG. 7 is a perspective view showing an example of a heating-type flavor inhaler.
FIG. 8 is a diagram showing an internal structure of a tobacco stick.
FIG. 9 is a diagram showing an internal structure of an aerosol-generation device.

DETAILED DESCRIPTION

[0018] Hereinafter, the present invention will be described in detail; however, the description provided below is intended to describe the present invention and not intended to limit the present invention.

[1. Tobacco Filler]

[0019] A tobacco filler includes:

a tobacco material; and
an antioxidant in an amount of 0.25% by mass or more with respect to the tobacco material.

[0020] The tobacco filler can be filled into a tobacco product and form a flavor source. The tobacco filler may be in the form of cut tobacco or in the form of a tobacco molded body.

<Tobacco Material>

[0021] If the tobacco filler is in the form of cut tobacco, the tobacco material is cut tobacco. If the tobacco filler is in the form of a tobacco molded body, the tobacco material may be a tobacco material used as a raw material for forming a tobacco molded body or may be a tobacco molded body. Examples of the "tobacco material used as a raw material for forming a tobacco molded body" include a ground product of leaf tobacco (hereinafter also referred to as "fine tobacco powder") or a base sheet made of tobacco residue.

<Explanation of Terms>

[0022] The "cut tobacco" is obtained by cutting leaf tobacco (i.e., aged tobacco leaves) into a predetermined size suitable for a tobacco product. "Leaf tobacco" is obtainable by subjecting leaves of tobacco plants to various processes including a drying process in a farm house, and subsequently one to several years of a long-term aging process in a leaf processing facility, as is publicly known in the art.

[0023] The "tobacco molded body" is obtained by molding a raw material derived from leaf tobacco into a specific shape. The "raw material derived from leaf tobacco" may be a ground product of leaf tobacco, or tobacco residue obtained in extraction treatment of leaf tobacco. The "raw material derived from leaf tobacco" may include waste leaf tobacco (leaf scrap) generated in leaf processing facilities or waste leaf tobacco (cut tobacco scrap) generated in manufacturing facilities. The tobacco molded body may be formed to have a size suitable for being incorporated into a tobacco product. Alternatively, the tobacco molded body may be formed in a large size first, and then cut into a size suitable for being incorporated into a tobacco product.

[0024] If the raw material derived from leaf tobacco is molded into a sheet shape, the tobacco molded body is referred to as "sheet tobacco"; and if the raw material derived from leaf tobacco is molded into a granular shape, the tobacco molded body is referred to as "tobacco granules". The sheet tobacco can be formed by a known method such as a papermaking method, a casting method, or a rolling method. If the tobacco molded body is formed by a papermaking method, it is referred to as "paper-processed sheet tobacco"; if the tobacco molded body is formed by a casting method, it is referred to as "slurry-processed sheet tobacco"; and if the tobacco molded body is formed by a rolling method, it is referred to as "rolling-processed sheet tobacco". The tobacco granules can be formed by a known method such as an extrusion granulation method or spray drying.

<Antioxidant>

[0025] The antioxidant that is used can be, for example, antioxidants known as food additives. Examples of the antioxidant include gallic acid, erythorbic acid, ascorbic acid, catechin, dihydrocaffeic acid, p-coumaric acid, ferulic acid, 3-(4-hydroxyphenyl)propionic acid, quercetin, esculetin, kaempferol, caffeic acid, tocopherol, dibutylhydroxytoluene (BHT), quinic acid, chlorogenic acid, rutin, scopoletin, and cinnamic acid. One type of antioxidant or multiple types of antioxidants in combination may be used. The antioxidant is preferably at least one selected from the group consisting of gallic acid and erythorbic acid.

[0026] As described above, the antioxidant is contained in the tobacco filler in an amount of 0.25% by mass or more with respect to the tobacco material. The amount of the antioxidant is generally 10% by mass or less with respect to the tobacco material. The antioxidant is contained in the tobacco filler in an amount of, for example, 0.25 to 10% by mass, preferably 0.25 to 5.0% by mass, with respect to the tobacco material. If multiple types of antioxidants are used in combination, the amount of the antioxidant refers to the total amount of the multiple types of antioxidants.

<Specific Embodiments>

[0027] Hereinafter, specific embodiments will be described.

(1-1. Case where a tobacco filler is in the form of cut tobacco)

[0028] As described above, a tobacco filler can be, for example, in the form of cut tobacco. Specifically, in a first embodiment, a tobacco filler includes cut tobacco and an antioxidant in an amount of 0.25% by mass or more with respect to the cut tobacco, and is in the form of cut tobacco. The tobacco filler according to the first embodiment can be prepared by, for example, spraying a liquid composition containing an antioxidant and a solvent onto cut tobacco, and drying the cut tobacco (see FIG. 3).

(1-2. Case where a tobacco filler is in the form of a tobacco molded body)

[0029] As described above, a tobacco filler can be, for example, in the form of a tobacco molded body. Preferably, the tobacco filler can be in the form of sheet tobacco.

(Paper-processed Sheet Tobacco)

[0030] In a second embodiment, a tobacco filler includes a base sheet made of tobacco residue, tobacco extract, and an antioxidant in an amount of 0.25% by mass or more with respect to the base sheet made of tobacco residue, and is in the form of sheet tobacco. The tobacco filler according to the second embodiment can be prepared by, for example, molding tobacco residue into a sheet shape by a papermaking technique, coating the obtained base sheet with a liquid composition containing an antioxidant and tobacco extract, and drying the obtained tobacco mixture (see FIG. 4). The tobacco filler according to the second embodiment is called "paper-processed sheet tobacco".

(Slurry-processed Sheet Tobacco)

[0031] In a third embodiment, a tobacco filler includes fine tobacco powder and an antioxidant in an amount of 0.25% by mass or more with respect to the fine tobacco powder, and is in the form of sheet tobacco. The tobacco filler according to the third embodiment can be prepared by, for example, mixing fine tobacco powder, an antioxidant, water, and, if necessary, an additive such as a binder, casting the obtained tobacco mixture into a sheet shape, and drying the sheet (see FIG. 5). The tobacco filler according to the third embodiment is referred to as "slurry-processed sheet tobacco".

(Tobacco Granules)

[0032] Alternatively, a tobacco filler can be in the form of tobacco granules. Specifically, in a fourth embodiment, a tobacco filler includes fine tobacco powder and an antioxidant in an amount of 0.25% by mass or more with respect to the fine tobacco powder, and is in the form of tobacco granules. The tobacco filler according to the fourth embodiment can be prepared by, for example, mixing fine tobacco powder, an antioxidant, water, and, if necessary, an additive such as a binder, granulating the obtained tobacco mixture into a granular shape, and drying the granules (see FIG. 6).

<Effects>

[0033] The tobacco fillers described above can be used in a heating-type flavor inhaler. The tobacco fillers described above can cause a reaction between the nitrite in the tobacco material and the antioxidant utilizing thermal energy generated by heating during use of the heating-type flavor inhaler, thereby suppressing the reaction of generating TSNA and reducing the amount of TSNA in the tobacco vapor, as shown in FIG. 2.

[0034] Since the above tobacco fillers can reduce the amount of TSNA in the tobacco vapor through the reaction utilizing the thermal energy generated during use of the heating-type flavor inhaler, as described above, it is unnecessary to perform an additional reaction step in the tobacco fillers in order to reduce the amount of TSNA. Therefore, the above tobacco fillers can achieve the effect of reducing the amount of TSNA without complicating the preparation process, as compared with conventional tobacco fillers. In addition, since the above tobacco fillers do not require an additional reaction step for reducing the amount of TSNA, they excel in terms of having no possibility of negatively affecting the quality characteristics (such as a smoking flavor) and physical characteristics (such as bulkiness) of the tobacco fillers.

[2. Method for Producing Tobacco Filler]

[0035] As explained above, the tobacco fillers described above fulfill the effect of reducing the amount of TSNA through the reaction of the antioxidant with the nitrite in the tobacco material utilizing the thermal energy generated during use of the heating-type flavor inhaler. Therefore, the antioxidant in the tobacco fillers is required to remain in the tobacco fillers without reacting with the nitrite in the tobacco material until a user uses the heating-type flavor inhaler.

[0036] The inventors of the present invention have experimentally confirmed that a reaction between an antioxidant and nitrite occurs almost not at all when heating is performed at 110 °C for 10 minutes in the presence of a predetermined amount of moisture, but may occur when heating is performed at a higher temperature or for a longer period of time or in the presence of a larger amount of moisture (see Example 2 below). On the other hand, a tobacco filler is not exposed to a high temperature condition that may cause a reaction between an antioxidant and nitrite, in the course of distribution of a heating-type flavor inhaler or in the course of storage by a user. Therefore, if a reaction between an antioxidant and nitrite is suppressed until a tobacco filler is incorporated into a heating-type flavor inhaler by a manufacturer, the antioxidant can remain in the tobacco filler without reacting with nitrite, until a user uses the heating-type flavor inhaler.

[0037] Accordingly, a method for producing a tobacco filler includes:

adding an antioxidant and a liquid to a tobacco material to prepare a tobacco mixture;
drying the tobacco mixture to prepare a tobacco filler; and
maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the tobacco material until incorporation of the tobacco filler into a heat-not-burn-type flavor inhaler is completed.

[0038] The "liquid" as used herein can be a solvent of the antioxidant (generally, water or alcohol such as ethanol), tobacco extract obtained by extraction treatment of leaf tobacco, a liquid for suspending the tobacco material (generally, water), or a combination thereof.

[0039] The expression "until incorporation of the tobacco filler into a heat-not-burn-type flavor inhaler is completed" may refer to "until the tobacco filler is incorporated into a main body of a heating-type flavor inhaler by a manufacturer" or "until the tobacco filler is incorporated by a manufacturer into a refill tobacco article (such as a tobacco stick), which is a component of a heating-type flavor inhaler."

[0040] In the method described above, the tobacco mixture and the tobacco filler are not placed under conditions that allow the antioxidant and the nitrite derived from the tobacco material to react with each other until the incorporation of the tobacco filler into the heating-type flavor inhaler is completed. Thus, the tobacco filler produced by the above method allows the antioxidant to remain without reacting with the nitrite derived from the tobacco material until a user uses the heating-type flavor inhaler, and allows the antioxidant to react with the nitrite only through the thermal energy generated during use of the heating-type flavor inhaler (see FIG. 2). As a result, it is possible to inhibit the reaction of generating TSNA that occurs during use of the heating-type flavor inhaler, and to reduce the amount of TSNA in the tobacco vapor (see FIG. 2).

<Preferred Embodiments>

[0041] Preferably, "maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the tobacco material until incorporation of the tobacco filler into a heating-type flavor inhaler is completed" can be achieved by performing the drying of the tobacco mixture under conditions that do not allow the antioxidant and the nitrite derived from the tobacco material to react with each other.

[0042] More preferably, the above-described maintenance can be achieved by performing the drying of the tobacco mixture under conditions of

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of drying.

[0043] The heating temperature is, for example, 35 to 110 °C. The heating time is, for example, 1 to 10 minutes. The moisture content is, for example, 20 to 400% by mass.

[0044] The heat-drying under the above conditions can efficiently dry the tobacco mixture and can also prevent the antioxidant from reacting with the nitrite derived from the tobacco material and being consumed.

[0045] The "moisture content at a start of drying" as used herein refers to a value represented by the following formula:

$$\text{Moisture content [\% by mass]} = (\text{mass of added water in tobacco mixture} / \text{total mass of tobacco material and additive in tobacco mixture}) \times 100$$

[0046] The "moisture content at a start of drying" determined by this formula indicates a mass % of the water contained in the liquid added to the tobacco material when the tobacco mixture is prepared. In this formula, the "total mass of tobacco material and additive in tobacco mixture" indicates a mass of the tobacco mixture excluding the added water.

[0047] Still more preferably, the above-described maintenance can be achieved by performing the drying of the tobacco mixture under conditions of:

(a) a heating temperature of 50 to 110 °C;
(b) a heating time of 1 to 10 minutes; and
(c) a moisture content of 25 to 400% by mass at a start of drying.

[0048] The heat-drying under such conditions can more reliably prevent the antioxidant from reacting with the nitrite derived from the tobacco material and being consumed, while efficiently drying the tobacco mixture.

[0049] Alternatively, if the proportion of the liquid in the tobacco mixture is small and there is no need to heat the tobacco mixture for drying, the above-described maintenance can be achieved by allowing the tobacco mixture to stand at room temperature without heating it. Specifically, the above-described maintenance can be achieved by allowing the tobacco mixture to stand under the conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80%. In this case, the tobacco mixture can be left to stand for an appropriate period until the tobacco mixture is dried, for example, for 2 to 365 days. Herein, allowing the tobacco mixture to stand under the above conditions is also referred to as "conditioned drying".

[0050] Therefore, in a preferred embodiment, a method for producing a tobacco filler includes:

adding an antioxidant and a liquid to a tobacco material to prepare a tobacco mixture; and
heat-drying the tobacco mixture under conditions of:

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of drying, or

allowing the tobacco mixture to stand under conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80% to dry the tobacco mixture.

[0051] The liquid as used herein can be a solvent of the antioxidant (generally, water or alcohol such as ethanol), a liquid for suspending the tobacco material (generally, water), tobacco extract obtained by extraction treatment of leaf tobacco, or a combination thereof.

<Specific Embodiments>

[0052] Hereinafter, specific embodiments will be described.

(2-1. Case where a tobacco filler is in the form of cut tobacco)

[0053] A tobacco filler can be, for example, in the form of cut tobacco. A method for producing a tobacco filler in the form of cut tobacco is shown in FIG. 3. Specifically, in this embodiment, a method for producing a tobacco filler can include:

adding a liquid composition containing an antioxidant and a solvent (e.g., water or alcohol such as ethanol) to cut tobacco to prepare a tobacco mixture;
drying the tobacco mixture to prepare a tobacco filler; and
maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the cut tobacco until incorporation of the tobacco filler into a heat-not-burn-type flavor inhaler is completed.

[0054] Hereinafter, the method according to this embodiment will be described in the order of the steps of the method. However, description will be omitted for the parts common to the above description.

(1) Preparation of Tobacco Mixture

[0055] In this embodiment, a tobacco mixture can be prepared by spraying a liquid composition containing an antioxidant and a solvent onto cut tobacco. Alternatively, a tobacco mixture can be prepared by immersing cut tobacco in a liquid composition containing an antioxidant and a solvent.

[0056] As described above, the "cut tobacco" is obtained by cutting leaf tobacco into a predetermined size suitable for a tobacco product.

[0057] As described above, the "antioxidant" that is used can be, for example, antioxidants known as food additives. Examples of the antioxidant include gallic acid, erythorbic acid, ascorbic acid, catechin, dihydrocaffeic acid, p coumaric acid, ferulic acid, 3-(4-hydroxyphenyl)propionic acid, quercetin, esculetin, kaempferol, caffeic acid, tocopherol, dibutylhydroxytoluene (BHT), quinic acid, chlorogenic acid, rutin, scopoletin, and cinnamic acid. One type of antioxidant or multiple types of antioxidants in combination may be used. The antioxidant is preferably at least one selected from the group consisting of gallic acid and erythorbic acid.

[0058] As described above, the antioxidant is added to the tobacco material so as to be contained in an amount of, for example, 0.25% by mass or more with respect to the tobacco material. The amount of the antioxidant is generally 10% by mass or less with respect to the tobacco material. The antioxidant is added to the tobacco material in an amount of, for example, 0.25 to 10% by mass, and preferably 0.25 to 5.0% by mass, with respect to the tobacco material. If multiple types of antioxidants are used in combination, the amount of the antioxidant refers to the total amount of the multiple types of antioxidants.

[0059] For example, water or alcohol such as ethanol can be used as the "solvent". The solvent is preferably used in an amount as small as possible for the efficiency of the subsequent drying. The solvent can be used in an amount of, for example, 0.1 to 12000% by mass with respect to the antioxidant.

(2) Drying

[0060] As described above, the tobacco mixture can be dried by performing heat-drying under conditions of:

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of drying, or

allowing the tobacco mixture to stand under conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80% to dry the tobacco mixture.

[0061] In this embodiment, the tobacco mixture is preferably not dried by heat-drying. That is, the tobacco mixture is preferably dried by being left to stand for, for example, 2 to 365 days under conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80%.

[0062] The tobacco mixture is preferably dried to an extent that will minimize a fracture caused by physical impact in the subsequent manufacturing steps or the like, and an example thereof is to perform drying until a tobacco mixture having a moisture content of about 13% by mass is obtained at the end of the drying. A tobacco filler is obtained by drying the tobacco mixture.

(3) Incorporation of Tobacco Filler into Heating-type Flavor Inhaler

[0063] The tobacco filler is incorporated into a heating-type flavor inhaler, whereby a heating-type flavor inhaler is manufactured. As described above, the tobacco filler may be incorporated into a main body of a heating-type flavor inhaler, or may be incorporated into a refill tobacco article, which is a component of a heating-type flavor inhaler. As a specific example of the latter, the tobacco filler may be incorporated into a tobacco stick by wrapping the tobacco filler with cigarette paper, or may be incorporated into a tobacco refill by containing the tobacco filler in a refill container.

[0064] In addition, the tobacco filler may be incorporated into a heating-type flavor inhaler by being mixed with an ordinary tobacco filler not containing an antioxidant, or may be incorporated into a heating-type flavor inhaler by itself without being mixed with the ordinary tobacco filler.

[0065] In the process of being incorporated into a heating-type flavor inhaler, the tobacco filler is not exposed to a high temperature condition. Thus, when the tobacco mixture is dried under the above-described conditions, the tobacco mixture and the tobacco filler can be maintained under the conditions for suppressing a reaction between the antioxidant and nitrite derived from cut tobacco until the incorporation of the tobacco filler into the heating-type flavor inhaler is completed.

(2-2. Case where the tobacco filler is in the form of a tobacco molded body)

[0066] A tobacco filler can be, for example, in the form of a tobacco molded body. Preferably, a tobacco filler can be in the form of sheet tobacco.

(Paper-processed Sheet Tobacco)

[0067] FIG. 4 shows a method for producing a tobacco filler in the form of paper-processed sheet tobacco. Specifically,

in this embodiment, a method for producing a tobacco filler can include:

adding a liquid composition containing an antioxidant and tobacco extract to a base sheet made of tobacco residue to prepare a tobacco mixture;
drying the tobacco mixture to prepare a tobacco filler; and
maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the tobacco residue and/or the tobacco extract until incorporation of the tobacco filler into a heating-type flavor inhaler is completed.

[0068] Hereinafter, the method according to this embodiment will be described in the order of the steps of the method. However, description will be omitted for the parts common to the above description.

(1) Preparation of Tobacco Mixture

[0069] The tobacco mixture can be prepared, for example, as follows. First, tobacco residue and tobacco extract are prepared by extraction treatment of leaf tobacco using hot water. The tobacco residue is molded into a sheet shape by a papermaking technique, and the obtained base sheet is coated with a liquid composition containing an antioxidant and the tobacco extract. In this manner, a tobacco mixture can be prepared.

[0070] In this embodiment, it is preferable to coat the base sheet with a liquid composition containing an antioxidant and the tobacco extract as soon as the liquid composition is prepared, in order to eliminate the possibility of the antioxidant reacting with nitrite contained in the tobacco extract.

[0071] In addition, since this embodiment involves coating the base sheet with an antioxidant, an antioxidant can be uniformly applied to the entire base sheet. Accordingly, the effect of the antioxidant can be uniformly exhibited over the entire tobacco filler.

(2) Drying

[0072] In this embodiment, the tobacco mixture can be dried by performing heat-drying under the following conditions, as described above:

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of drying.

[0073] For the details of the heat-drying conditions, the above description can be referred to.

[0074] The tobacco mixture is preferably dried to an extent that will minimize a fracture caused by physical impact in the subsequent manufacturing steps or the like, and an example thereof is to perform drying until a tobacco mixture having a water content of about 13% by mass is obtained at the end of the drying. A tobacco filler in the form of paper-processed sheet tobacco is obtained by drying the tobacco mixture.

(3) Incorporation of Tobacco Filler into Heating-type Flavor Inhaler

[0075] In this embodiment, the tobacco filler is in the form of paper-processed sheet tobacco. Thus, the tobacco filler is cut into an appropriate size (such as a size equivalent to that of ordinary cut tobacco), if necessary, and then incorporated into a heating-type flavor inhaler. In this manner, a heating-type flavor inhaler is manufactured.

[0076] In this embodiment as well, the tobacco filler is not exposed to a high temperature condition in the process of being incorporated into a heating-type flavor inhaler. Thus, when the tobacco mixture is dried under the above-described conditions, the tobacco mixture and the tobacco filler can be maintained under a condition for suppressing a reaction between the antioxidant and nitrite derived from the tobacco residue and/or the tobacco extract until the incorporation of the tobacco filler into the heating-type flavor inhaler is completed.

(4) Another Producing Method

[0077] Alternatively, a tobacco filler in the form of paper-processed sheet tobacco can be produced by another method. Specifically, first, a base sheet made of tobacco residue is prepared by a papermaking technique, and coated with tobacco extract, whereby ordinary paper-processed sheet tobacco (containing no antioxidant) is prepared. Then, a liquid composition containing an antioxidant and a solvent is sprayed onto the ordinary paper-processed sheet tobacco, followed by drying. In this manner as well, a tobacco filler in the form of paper-processed sheet tobacco can be produced.

[0078] The spraying and drying can be performed in the same manner as in the case of the tobacco filler in the form of cut tobacco. That is, the drying is preferably not performed by heat-drying; specifically, the drying is preferably performed by allowing the tobacco mixture to stand for, for example, 2 to 365 days under the conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80%.

(Slurry-processed Sheet Tobacco)

[0079] FIG. 5 shows a method for producing a tobacco filler in the form of slurry-processed sheet tobacco. Specifically, in this embodiment, a method for producing a tobacco filler can include:

mixing fine tobacco powder with an antioxidant and water (and an additive, if necessary) to prepare a tobacco mixture;
casting the tobacco mixture into a sheet shape and then drying the sheet-shaped tobacco mixture to prepare a tobacco filler; and
maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the fine tobacco powder until incorporation of the tobacco filler into a heating-type flavor inhaler is completed.

[0080] Hereinafter, the method according to this embodiment will be described in the order of the steps of the method. However, description will be omitted for the parts common to the above description.

(1) Preparation of Tobacco Mixture

[0081] In this embodiment, an antioxidant is added to a raw material slurry (e.g., a mixture of fine tobacco powder, water, a binder, and glycerin) used in the preparation of ordinary slurry-processed sheet tobacco.

[0082] Since this embodiment involves adding an antioxidant to a raw material slurry, an antioxidant can be uniformly added to an entire raw material slurry. Accordingly, the effect of the antioxidant can be uniformly exhibited over the entire tobacco filler.

(2) Molding and Drying

[0083] In this embodiment, the molding and drying of the tobacco mixture can be performed by:

casting a raw material slurry containing an antioxidant (i.e., the tobacco mixture) on a metal plate heated in advance, and
performing heat-drying under the following conditions, as described above:

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of drying.

[0084] For the details of the heat-drying conditions, the above description can be referred to.

[0085] The tobacco mixture is preferably dried to an extent that will minimize a fracture caused by physical impact in the subsequent manufacturing steps or the like, and an example thereof is to perform drying until a tobacco mixture having a moisture content of about 13% by mass is obtained at the end of the drying. A tobacco filler in the form of slurry-processed sheet tobacco is obtained by drying the tobacco mixture.

(3) Incorporation of Tobacco Filler into Heating-type Flavor Inhaler

[0086] In this embodiment, the tobacco filler is in the form of slurry-processed sheet tobacco. Thus, the tobacco filler is cut into an appropriate size (such as a size equivalent to that of ordinary cut tobacco), if necessary, and then incorporated into a heating-type flavor inhaler. In this manner, a heating-type flavor inhaler is manufactured.

[0087] In this embodiment as well, the tobacco filler is not exposed to a high temperature condition in the process of being incorporated into a heating-type flavor inhaler. Thus, when the tobacco mixture is dried under the above-described conditions, the tobacco mixture and the tobacco filler can be maintained under a condition for suppressing a reaction between the antioxidant and nitrite derived from the fine tobacco powder until the incorporation of the tobacco filler into the heating-type flavor inhaler is completed.

(4) Another Producing Method

[0088] Alternatively, a tobacco filler in the form of slurry-processed sheet tobacco can be produced by another method. Specifically, a tobacco filler in the form of slurry-processed sheet tobacco can also be produced by preparing ordinary slurry-processed sheet tobacco (containing no antioxidant), spraying a liquid composition containing an antioxidant and a solvent onto the ordinary slurry-processed sheet tobacco, and drying the slurry-processed sheet tobacco.

[0089] The spraying and drying can be performed in the same manner as in the case of the tobacco filler in the form of cut tobacco. That is, the drying is preferably not performed by heat-drying; specifically, the drying is preferably performed by allowing the tobacco mixture to stand for, for example, 2 to 365 days under the conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80%.

(Tobacco Granules)

[0090] Alternatively, a tobacco filler can be in the form of tobacco granules. FIG. 6 shows a method for producing a tobacco filler in the form of tobacco granules. Specifically, in this embodiment, a method for producing a tobacco filler can include:

mixing fine tobacco powder with an antioxidant and water (and an additive, if necessary) to prepare a tobacco mixture;
molding the tobacco mixture into granules and then drying the granules to prepare a tobacco filler; and
maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the fine tobacco powder until incorporation of the tobacco filler into a heating-type flavor inhaler is completed.

[0091] Hereinafter, the method according to this embodiment will be described in the order of the steps of the method. However, description will be omitted for the parts common to the above description.

(1) Preparation of Tobacco Mixture

[0092] In this embodiment, an antioxidant is added to a raw material mixed solution (e.g., a mixture of fine tobacco powder, water, and a binder) used in the preparation of ordinary tobacco granules.

[0093] Since this embodiment involves adding an antioxidant to a raw material mixed solution, an antioxidant can be uniformly added to an entire raw material mixed solution. Accordingly, the effect of the antioxidant can be uniformly exhibited over the entire tobacco filler.

(2) Molding and Drying

[0094] In this embodiment, the molding and drying of the tobacco mixture can be performed by:

molding a raw material mixed solution containing an antioxidant (i.e., the tobacco mixture) into granules by a known granulation method; and
performing heat-drying under the following conditions, as described above:

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of drying.

[0095] For the details of the heat-drying conditions, the above description can be referred to.

[0096] If the tobacco mixture is molded into granules by spray drying, the molding and drying may occur substantially simultaneously. The tobacco mixture is preferably dried to an extent that will minimize a fracture caused by physical impact in the subsequent manufacturing steps or the like, and an example thereof is to perform drying until a tobacco mixture having a moisture content of about 13% by mass is obtained at the end of the drying. A tobacco filler in the form of tobacco granules is obtained by drying the tobacco mixture.

(3) Incorporation of Tobacco Filler into Heating-type Flavor Inhaler

[0097] In this embodiment, the tobacco filler is in the form of tobacco granules. The tobacco granules are incorporated into a heating-type flavor inhaler, whereby a heating-type flavor inhaler is manufactured.

[0098] In this embodiment as well, the tobacco filler is not exposed to a high temperature condition in the process of

being incorporated into a heating-type flavor inhaler. Thus, when the tobacco mixture is dried under the above-described conditions, the tobacco mixture and the tobacco filler can be maintained under a condition for suppressing a reaction between the antioxidant and nitrite derived from the fine tobacco powder until the incorporation of the tobacco filler into the heating-type flavor inhaler is completed.

(4) Another Producing Method

[0099] Alternatively, a tobacco filler in the form of tobacco granules can be produced by another method. Specifically, a tobacco filler in the form of tobacco granules can also be produced by preparing ordinary tobacco granules (containing no antioxidant), spraying a liquid composition containing an antioxidant and a solvent onto the ordinary tobacco granules, and drying the tobacco granules.

[0100] The spraying and drying can be performed in the same manner as for the tobacco filler in the form of cut tobacco. That is, the drying is preferably not performed by heat-drying; specifically, the drying is preferably performed by allowing the tobacco mixture to stand for, for example, 2 to 365 days under the conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80%.

<Effects>

[0101] The method for producing a tobacco filler differs from the existing method only in that an antioxidant is added to a raw material, and is a simple method.

[0102] According to another aspect, there is provided a tobacco filler produced by the method described above. The tobacco filler produced by the above method allows the antioxidant to remain without reacting with the nitrite derived from the tobacco material until a user uses the heating-type flavor inhaler, and allows the antioxidant to react with the nitrite only through the thermal energy generated during use of the heating-type flavor inhaler (see FIG. 2). As a result, it is possible to inhibit the reaction of generating TSNA that occurs during use of the heating-type flavor inhaler, and to reduce the amount of TSNA in the tobacco vapor (see FIG. 2).

[0103] Since the above tobacco filler can reduce the amount of TSNA in the tobacco vapor through the reaction utilizing the thermal energy generated during use of the heating-type flavor inhaler, as described above, it is unnecessary to perform an additional reaction step in the tobacco filler in order to reduce the amount of TSNA. Therefore, the above tobacco filler can achieve the effect of reducing the amount of TSNA without complicating the preparation process, as compared with conventional tobacco fillers. In addition, since the above tobacco filler does not require an additional reaction step for reducing the amount of TSNA, it excels in terms of having no possibility of negatively affecting the quality characteristics (such as a smoking flavor) and physical characteristics (such as bulkiness) of the tobacco filler.

[3. Heat-not-burn-type Flavor Inhaler]

[0104] According to another aspect, there is provided a heat-not-burn-type flavor inhaler containing a flavor source including the tobacco filler described in <1. Tobacco Filler>.

[0105] According to still another aspect, there is provided a heat-not-burn-type flavor inhaler containing a flavor source including the tobacco filler produced by the method described in <2. Method for Producing Tobacco Filler>.

[0106] Therefore, the expression "the above tobacco filler" used in the following description refers to both the tobacco filler described in <1. Tobacco Filler> and the tobacco filler produced by the method described in <2. Method for Producing Tobacco Filler>.

[0107] A heat-not-burn-type flavor inhaler containing the above tobacco filler (hereinafter simply referred to as a "heating-type flavor inhaler") has the same configuration as those of the existing heating-type flavor inhalers except that a part or whole of the tobacco filler of the existing heating-type flavor inhalers is replaced with the above tobacco filler.

[0108] For example, the above tobacco filler can have a size equivalent to that of ordinary cut tobacco. The above tobacco filler may be used alone as the flavor source of the heating-type flavor inhaler, or used in combination with ordinary cut tobacco, ordinary sheet tobacco, or the like as the flavor source of the heating-type flavor inhaler. That is, the above tobacco filler can be incorporated into a heating-type flavor inhaler in an amount of 5 to 100% by mass with respect to the entire tobacco filler (i.e., flavor source) of the heating-type flavor inhaler.

[0109] In the heating-type flavor inhaler, the flavor source including the above tobacco filler is heated to a temperature of, for example, 150 °C or higher. In the heating-type flavor inhaler, the flavor source including the above tobacco filler is heated to a temperature of preferably 150 to 400 °C, and more preferably 200 to 400 °C.

[0110] The heating-type flavor inhaler containing the above tobacco filler can cause a reaction between the nitrite in the tobacco material and the antioxidant utilizing thermal energy generated by heating during use of the heating-type flavor inhaler, thereby suppressing the reaction of generating TSNA and reducing the amount of TSNA in the tobacco vapor, as shown in FIG. 2.

[0111] Examples of the heating-type flavor inhaler include:

a carbon heat source-type inhaler that heats a tobacco filler with combustion heat of a carbon heat source (see, for example, WO 2006/073065);
an electric heating-type inhaler having a tobacco stick containing a tobacco filler and a heating device for electrically heating the tobacco stick (see, for example, WO 2010/110226); and
a liquid atomizing-type inhaler in which a liquid aerosol source is heated by a heater to generate aerosol and a flavor derived from a tobacco filler is inhaled together with the aerosol (see, for example, WO 2015/046385).

<Preferred Embodiments>

[0112] According to a preferred embodiment, there is provided a heating-type flavor inhaler including:

a flavor source including the above tobacco filler; and
a heater for heating the flavor source.

[0113] In this embodiment, the heating-type flavor inhaler may further include an aerosol source. The aerosol source may be included in admixture with the flavor source or may be included in a separate compartment from the flavor source (e.g., on an upstream side of the flavor source).

[0114] In this embodiment, the heater may be built in a main body of the heating-type flavor inhaler that contains the flavor source, or may be provided as a separate device from a refill tobacco article (such as a tobacco stick) that contains the flavor source.

[0115] According to a more preferred embodiment, there is provided a heating-type flavor inhaler including:

a tobacco stick including: a flavor source including the above tobacco filler; and cigarette paper wrapped around the flavor source, and
a heater for heating the tobacco stick.

[0116] In this embodiment, the aerosol source may be included in an admixture with the flavor source.

<Example of Heating-type Flavor Inhaler>

[0117] Hereinafter, an example of the heating-type flavor inhaler will be described with reference to FIGS. 7 to 9. FIG. 7 is a perspective view showing an example of a heating-type flavor inhaler. FIG. 8 is a diagram showing an internal structure of a tobacco stick. FIG. 9 is a diagram showing an internal structure of an aerosol-generation device.

[0118] As shown in FIG. 7, a heating-type flavor inhaler 100 includes:

a tobacco stick 110 including: a flavor source including the above tobacco filler; and an aerosol source; and
an aerosol-generation device 120 to which the tobacco stick 110 is detachably attached, and which heats the tobacco stick 110 to generate aerosol from the aerosol source and release a flavor component from the tobacco filler by an action of the aerosol.

[0119] The tobacco stick 110 is a replaceable cartridge and has a columnar shape extending along the longitudinal direction. The tobacco stick 110 is configured to generate aerosol and a flavor component by being heated while being inserted into the aerosol-generation device 120.

[0120] As shown in FIG. 8, the tobacco stick 110 includes a base portion 11A including a filler 111 and first cigarette paper 112 wrapped around the filler 111, and a mouthpiece portion 11B forming an end opposite to the base portion 11A. The base portion 11A and the mouthpiece portion 11B are connected by second cigarette paper 113.

[0121] The mouthpiece portion 11B includes a paper tube portion 114, a filter portion 115, and a hollow segment portion 116 disposed between the paper tube portion 114 and the filter portion 115. The paper tube portion 114 is a paper tube formed by winding paper in a cylindrical shape, and has a hollow inside. The filter portion 115 includes a filter material such as acetate tow. The hollow segment portion 116 includes a filling layer having one or more hollow channels. The filter material of the filter portion 115 and the filling layer of the hollow segment portion 116 are connected by being covered with a plug wrapper 117. The filling layer is formed of fibers and has a high filling density of fibers; therefore, during inhalation, air or aerosol flows only through the hollow channel and hardly flows through the filling layer. In the tobacco stick 110, when the decrease of aerosol components through filtration in the filter portion 115 is desired to be diminished, it is effective to shorten the length of the filter portion 115 and replace it with the hollow segment portion 116 in order to increase a delivery amount of aerosol.

[0122] Although the mouthpiece portion 11B is composed of three segments, the mouthpiece portion 11B may be composed of one or two segments, or may be composed of four or more segments. For example, the hollow segment portion 116 may be omitted, and the paper tube portion 114 and the filter portion 115 may be disposed adjacent to each other to form the mouthpiece portion 11B.

[0123] The longitudinal length of the tobacco stick 110 is preferably 40 to 90 mm, more preferably 50 to 75 mm, and still more preferably 50 to 60 mm. The circumference of the tobacco stick 110 is preferably 15 to 25 mm, more preferably 17 to 24 mm, and still more preferably 20 to 23 mm. In addition, in the longitudinal direction of the tobacco stick 110, the base portion 11A may have a length of 20 mm, the paper tube portion 114 may have a length of 20 mm, the hollow segment portion 116 may have a length of 8 mm, and the filter portion 115 may have a length of 7 mm, and the lengths of these individual segments can be changed as appropriate according to production suitability, required quality, and the like.

[0124] The filler 111 includes: a flavor source including the above tobacco filler; and an aerosol source. The aerosol source is heated at a predetermined temperature to generate aerosol. The aerosol source may be, for example, glycerin, propylene glycol, triacetin, 1,3-butanediol, and a mixture thereof. The content of the aerosol source in the filler 111 is not particularly limited, and from the viewpoint of generating a sufficient amount of aerosol and providing a good smoking flavor, the content is usually 5% by mass or more, preferably 10% by mass or more, and usually 50% by mass or less, preferably 20% by mass or less.

[0125] The tobacco filler is, for example, in the form of cut tobacco or in the form of a tobacco molded body, as described above. If the tobacco filler is in the form of cut tobacco, it may be in the form of cut tobacco obtained by cutting leaf tobacco (i.e., aged tobacco leaves) into widths of, for example, 0.8 to 1.2 mm. Alternatively, if the tobacco filler is in the form of sheet tobacco, it may be in the form of elongated sheet tobacco obtained by cutting sheet tobacco into widths of, for example, 0.8 to 1.2 mm, or may be in the form of corrugated sheet tobacco obtained by gathering sheet tobacco without cutting it.

[0126] If the base portion 11A has a circumference of 22 mm and a length of 20 mm, the content of the filler 111 in the tobacco stick 110 is, for example, 200 to 400 mg, and preferably 250 to 320 mg. The moisture content of the filler 111 is, for example, 8 to 18% by mass, and preferably 10 to 16% by mass. Such a moisture content suppresses generation of a stain on the wrapping paper and improves roll-up machinability during manufacture of the base portion 11A.

[0127] For the first cigarette paper 112, the second cigarette paper 113, and the plug wrapper 117, the same cigarette paper, tipping paper, and plug wrapper as those used in a cigarette can be used.

[0128] As shown in FIG. 9, the aerosol-generation device 120 includes an insertion hole 130 into which the tobacco stick 110 can be inserted. That is, the aerosol-generation device 120 includes an inner tubular member 132 constituting the insertion hole 130. The inner tubular member 132 may be formed of a heat conductive member such as aluminum or stainless steel (SUS).

[0129] Further, the aerosol-generation device 120 may include a lid portion 140 that closes the insertion hole 130. The lid portion 140 is configured to be slidable between a state where the insertion hole 130 is closed and a state where the insertion hole 130 is exposed (see FIG. 7).

[0130] The aerosol-generation device 120 may include an air flow path 160 communicating with the insertion hole 130. One end of the air flow path 160 is connected to the insertion hole 130, while the other end of the air flow path 160 communicates with the outside (outside air) of the aerosol-generation device 120 at a portion different from the insertion hole 130.

[0131] The aerosol-generation device 120 may include a lid portion 170 that covers an end portion of the air flow path 160 on the side communicating with the outside air. The lid portion 170 can cover the end portion of the air flow path 160 on the side communicating with the outside air, or can expose the air flow path 160.

[0132] The lid portion 170 does not air-tightly close the air flow path 160 even in a state of covering the air flow path 160. That is, even in a state where the lid portion 170 covers the air flow path 160, the outside air can flow into the air flow path 160 via the vicinity of the lid portion 170.

[0133] In a state where the tobacco stick 110 is inserted into the aerosol-generation device 120, the user holds, in the mouth, one end portion of the tobacco stick 110, specifically, the mouthpiece portion 11B shown in FIG. 8, and performs an inhalation action. The outside air flows into the air flow path 160 through the user's inhalation action. The air flowing into the air flow path 160 passes through the tobacco stick 110 in the insertion hole 130 and is guided into an oral cavity of the user.

[0134] The aerosol-generation device 120 may include a temperature sensor in the air flow path 160 or on an outer surface of a wall portion constituting the air flow path 160. The temperature sensor may be, for example, a thermistor, a thermocouple, or the like. When the user inhales with the mouthpiece portion 11B of the tobacco stick 110, the internal temperature of the air flow path 160 or the temperature of the wall portion constituting the air flow path 160 decreases because of the influence of the air flowing through the air flow path 160 from the lid portion 170 side toward a heater 30 side. The temperature sensor can detect the user's inhalation action by measuring this temperature decrease.

[0135] The aerosol-generation device 120 includes a battery 10, a control unit 20, and a heater 30. The battery 10

stores electric power for use in the aerosol-generation device 120. The battery 10 may be a chargeable and dischargeable secondary battery. The battery 10 may be, for example, a lithium ion battery.

[0136] The heater 30 may be provided around the inner tubular member 132. The space accommodating the heater 30 and the space accommodating the battery 10 may be separated from each other by a partition wall 180. This can prevent the air heated by the heater 30 from flowing into the space accommodating the battery 10. Therefore, an increase in the temperature of the battery 10 can be suppressed.

[0137] The heater 30 preferably has a tubular shape capable of heating the outer periphery of the columnar tobacco stick 110. The heater 30 may be, for example, a film heater. The film heater may include a pair of film-like substrates and a resistance heating element sandwiched between the pair of substrates. The film-like substrate is preferably made of a material excellent in heat resistance and electrical insulating properties, and is typically made of polyimide. The resistance heating element is preferably made of one or two or more metal materials such as copper, nickel alloy, chromium alloy, stainless steel, and platinum rhodium, and may be formed of, for example, a base material made of stainless steel. Further, in order to connect the resistance heating element to a power source by a flexible printed circuit (FPC), copper plating may be applied to a connection portion and a lead portion thereof.

[0138] Preferably, a heat-shrinkable tube may be provided outside the heater 30. The heat-shrinkable tube is a tube that shrinks in a radial direction through heat, and is made of, for example, a thermoplastic elastomer. The heater 30 is pressed against the inner tubular member 132 by the contraction action of the heat-shrinkable tube. This increases the adhesion between the heater 30 and the inner tubular member 132, thereby increasing conduction of the heat from the heater 30 to the tobacco stick 110 via the inner tubular member 132.

[0139] The aerosol-generation device 120 may include a tubular thermal insulator on the outer side of the heater 30 in the radial direction, preferably on the outer side of the heat-shrinkable tube. The thermal insulator may serve to prevent the outer surface of the housing of the aerosol-generation device 120 from reaching an excessively high temperature by blocking the heat of the heater 30. The thermal insulator may be made of an aerogel such as a silica aerogel, a carbon aerogel, or an alumina aerogel. The aerogel as a thermal insulator may typically be a silica aerogel having high thermal insulation performance and relatively low manufacturing costs. However, the thermal insulator may be a fiber-based thermal insulator such as glass wool or rock wool, or a foam-based thermal insulator such as urethane foam or phenolic foam. Alternatively, the thermal insulator may be a vacuum thermal insulator.

[0140] The thermal insulator may be provided between the inner tubular member 132 facing the tobacco stick 110 and an outer tubular member 134 outside the thermal insulator. The outer tubular member 134 may be formed of a heat conductive member such as aluminum or stainless steel (SUS). It is preferable that the thermal insulator be provided in the sealed space.

[0141] The control unit 20 may include a control board, a CPU, a memory, and the like. The aerosol-generation device 120 may include a notification unit for notifying the user of various kinds of information under the control of the control unit 20. The notification unit may be, for example, a light emitting element such as an LED, a vibration element, or a combination thereof.

[0142] Upon detecting an activation request from the user, the control unit 20 starts supplying power from the battery 10 to the heater 30. The activation request from the user is made by, for example, an operation of a push button or a slide switch by the user, or an inhalation action of the user. The activation request from the user may be made by pressing a push button 150. More specifically, the activation request from the user may be made by pressing the push button 150 in a state where the lid portion 140 is opened. Alternatively, the activation request from the user may be made by detection of an inhalation action of the user. The user's inhalation action can be detected by, for example, such a temperature sensor as described above.

<4. Preferred Embodiments>

[0143] Hereinafter, preferred embodiments will be described.

[0144] [A1] A tobacco filler including:

a tobacco material; and
an antioxidant in an amount of 0.25% by mass or more with respect to the tobacco material.

[0145] [A2] The tobacco filler according to [A1], wherein the tobacco material is a ground product of leaf tobacco (that is, fine tobacco powder) or a base sheet made of tobacco residue.

[0146] [A3] The tobacco filler according to [A1] or [A2], wherein the tobacco filler is in a form of a tobacco molded body.

[0147] [A4] The tobacco filler according to any one of [A1] to [A3], wherein the tobacco filler is in a form of sheet tobacco.

[0148] [A5] The tobacco filler according to any one of [A1] to [A4], wherein the tobacco material is a ground product of leaf tobacco (that is, fine tobacco powder), and the tobacco filler is in a form of sheet tobacco.

[0149] [A6] The tobacco filler according to any one of [A1] to [A4], wherein the tobacco material is a base sheet made

of tobacco residue, and the tobacco filler is in a form of sheet tobacco.

[0150] [A7] The tobacco filler according to [A1], wherein the tobacco material is cut tobacco.

[0151] [A8] The tobacco filler according to [A1] or [A7], wherein the tobacco filler is in a form of cut tobacco.

[0152] [A9] The tobacco filler according to any one of [A1] to [A8], wherein the antioxidant is at least one selected from the group consisting of gallic acid, erythorbic acid, ascorbic acid, catechin, dihydrocaffeic acid, p-coumaric acid, ferulic acid, 3-(4-hydroxyphenyl)propionic acid, quercetin, esculetin, kaempferol, caffeic acid, tocopherol, dibutylhydroxytoluene (BHT), quinic acid, chlorogenic acid, rutin, scopoletin, and cinnamic acid.

[0153] [A10] The tobacco filler according to any one of [A1] to [A9], wherein the antioxidant is at least one selected from the group consisting of gallic acid and erythorbic acid.

[0154] [A11] The tobacco filler according to any one of [A1] to [A10], wherein the antioxidant is gallic acid.

[0155] [A12] The tobacco filler according to any one of [A1] to [A10], wherein the antioxidant is erythorbic acid.

[0156] [A13] The tobacco filler according to any one of [A1] to [A12], wherein an amount of the antioxidant is 10% by mass or less with respect to the tobacco material.

[0157] [A14] The tobacco filler according to any one of [A1] to [A13], wherein an amount of the antioxidant is 0.25 to 5.0% by mass with respect to the tobacco material.

[0158] [B1] A heat-not-burn-type flavor inhaler including a flavor source including the tobacco filler according to any one of [A1] to [A14].

[0159] [B2] The heat-not-burn-type flavor inhaler according to [B1], wherein the flavor source is heated to a temperature of 150 °C or higher.

[0160] [B3] The heat-not-burn-type flavor inhaler according to [B1] or [B2], wherein the flavor source is heated to a temperature of 150 to 400 °C, preferably 200 to 400 °C.

[0161] [B4] The heat-not-burn-type flavor inhaler according to any one of [B1] to [B3], further including a heater for heating the flavor source.

[0162] [B5] The heat-not-burn-type flavor inhaler according to any one of [B1] to [B4], including:

a tobacco stick including the flavor source and cigarette paper wrapped around the flavor source; and
a heater for heating the tobacco stick.

[0163] [C1] A method for producing a tobacco filler, the method including:

adding an antioxidant and a liquid to a tobacco material to prepare a tobacco mixture;
drying the tobacco mixture to prepare a tobacco filler; and
maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the tobacco material until incorporation of the tobacco filler into a heat-not-burn-type flavor inhaler is completed.

[0164] [C2] The method according to [C1], wherein the liquid is water, alcohol, or tobacco extract.

[0165] [C3] The method according to [C1] or [C2], wherein the maintaining is achieved by performing the drying of the tobacco mixture under conditions of:

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of the drying.

[0166] [C4] The method according to [C3], wherein the heating temperature is 35 to 110 °C, the heating time is 1 to 10 minutes, and the moisture content is 20 to 400% by mass.

[0167] [C5] The method according to [C3] or [C4], wherein the heating temperature is 50 to 110 °C, the heating time is 1 to 10 minutes, and the moisture content is 25 to 400% by mass.

[0168] [C6] The method according to [C1] or [C2], wherein the maintaining is achieved by allowing the tobacco mixture to stand under conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80%.

[0169] [C7] A method for producing a tobacco filler, the method including:

adding an antioxidant and a liquid to a tobacco material to prepare a tobacco mixture; and
heat-drying the tobacco mixture under conditions of

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of drying, or

allowing the tobacco mixture to stand under conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80% to dry the tobacco mixture.

[0170] [C8] The method according to [C7], wherein the liquid is water, alcohol, or tobacco extract.

[0171] [C9] The method according to [C7] or [C8], wherein the heating temperature is 35 to 110 °C, the heating time is 1 to 10 minutes, and the moisture content is 20 to 400% by mass.

[0172] [C10] The method according to any one of [C7] to [C9], wherein the heating temperature is 50 to 110 °C, the heating time is 1 to 10 minutes, and the moisture content is 25 to 400% by mass.

[0173] [C11] The method according to any one of [C1] to [C10], wherein the tobacco material is a ground product of leaf tobacco (that is, fine tobacco powder) or a base sheet made of tobacco residue.

[0174] [C12] The method according to any one of [C1] to [C11], wherein the tobacco filler is in a form of a tobacco molded body.

[0175] [C13] The method according to any one of [C1] to [C12], wherein the tobacco filler is in a form of sheet tobacco.

[0176] [C14] The method according to any one of [C1] to [C13], wherein the method further includes molding the tobacco mixture into a tobacco molded body before the drying.

[0177] [C15] The method according to any one of [C1] to [C14], wherein the tobacco material is a ground product of leaf tobacco (that is, fine tobacco powder), the liquid is water, the tobacco filler is in a form of sheet tobacco, and the method further includes molding the tobacco mixture into a sheet-shaped tobacco molded body before the drying.

[0178] [C16] The method according to any one of [C1] to [C14], wherein the tobacco material is a base sheet made of tobacco residue, the liquid is tobacco extract, and the tobacco filler is in a form of sheet tobacco.

[0179] [C17] The method according to any one of [C1] to [C10], wherein the tobacco material is cut tobacco.

[0180] [CI8] The method according to any one of [C1] to [C10] and [C17], wherein the tobacco filler is in a form of cut tobacco.

[0181] [C19] The method according to any one of [C1] to [C10], [C17], and [C18], wherein the tobacco material is cut tobacco, the liquid is water or alcohol, and the tobacco filler is in a form of cut tobacco.

[0182] [C20] The method according to any one of [C1] to [C19], wherein the antioxidant is at least one selected from the group consisting of gallic acid, erythorbic acid, ascorbic acid, catechin, dihydrocaffeic acid, p-coumaric acid, ferulic acid, 3-(4-hydroxyphenyl)propionic acid, quercetin, esculetin, kaempferol, caffeic acid, tocopherol, dibutylhydroxytoluene (BHT), quinic acid, chlorogenic acid, rutin, scopoletin, and cinnamic acid.

[0183] [C21] The method according to any one of [C1] to [C20], wherein the antioxidant is at least one selected from the group consisting of gallic acid and erythorbic acid.

[0184] [C22] The method according to any one of [C1] to [C21], wherein the antioxidant is gallic acid.

[0185] [C23] The method according to any one of [C1] to [C21], wherein the antioxidant is erythorbic acid.

[0186] [C24] The method according to any one of [C1] to [C23], wherein an amount of the antioxidant is 0.25% by mass or more with respect to the tobacco material.

[0187] [C25] The method according to any one of [C1] to [C24], wherein an amount of the antioxidant is 10% by mass or less with respect to the tobacco material.

[0188] [C26] The method according to any one of [C1] to [C25], wherein an amount of the antioxidant is 0.25 to 5.0% by mass with respect to the tobacco material.

[0189] [Dl] A tobacco filler obtainable by the method according to any one of [C1] to [C26].

[0190] [E1] A heat-not-burn-type flavor inhaler including a flavor source including the tobacco filler according to [D1].

[0191] [E2] The heat-not-burn-type flavor inhaler according to [E1], wherein the flavor source is heated to a temperature of 150 °C or higher.

[0192] [E3] The heat-not-burn-type flavor inhaler according to [E1] or [E2], wherein the flavor source is heated to a temperature of 150 to 400 °C, preferably 200 to 400 °C.

[0193] [E4] The heat-not-burn-type flavor inhaler according to any one of [E1] to [E3], further including a heater for heating the flavor source.

[0194] [E5] The heat-not-burn-type flavor inhaler according to any one of [E1] to [E4], including:

a tobacco stick including the flavor source and cigarette paper wrapped around the flavor source; and
a heater for heating the tobacco stick.

[Examples]

[Example 1]

[0195] In Example 1, the effect of addition of an antioxidant to a tobacco material on the amount of TSNA contained in a tobacco vapor was evaluated.

[1-1. Preparation of Tobacco Filler]

a) Cut tobacco

[0196] Burley cut tobacco was used as a tobacco material. The cut tobacco was sprayed with a liquid composition containing an antioxidant and a solvent and subjected to conditioned drying (22 °C, 60% RH, 2 days). Depending on the type of antioxidant, the solvent used was either water or ethanol. "Conditioned drying" refers to drying in an air-conditioned environment without heating. In this manner, a tobacco filler in the form of cut tobacco was prepared.

[0197] As a control, a tobacco filler in the form of cut tobacco was prepared in the same manner except that the liquid composition was not sprayed onto the cut tobacco.

b) Paper-processed Sheet Tobacco A

[0198] First, tobacco residue and tobacco extract were prepared by extraction treatment of leaf tobacco (burley tobacco : flue-cured tobacco = 7 : 3) using hot water. A base sheet was prepared by molding the tobacco residue into a sheet with a papermaking technique. The base sheet made of the tobacco residue was coated with the tobacco extract with an antioxidant added thereto, and heat-drying at normal pressure (heating temperature: 100 °C, heating time: 8 minutes, moisture content at a start of drying: 50% by mass) was performed. In this manner, a tobacco filler in the form of paper-processed sheet tobacco was prepared. This type of tobacco filler is referred to as "paper-processed sheet tobacco A".

[0199] As a control, a tobacco filler in the form of paper-processed sheet tobacco was prepared in the same manner except that tobacco extract with no antioxidant added thereto was used.

c) Paper-processed Sheet Tobacco B

[0200] A tobacco material part (i.e., paper-processed sheet tobacco) of a tobacco stick of Ploom S product (MEVIUS REGULAR TASTE for Ploom S, JAPAN TOBACCO INC.) was sprayed with a liquid composition containing an antioxidant and a solvent and subjected to conditioned drying (22 °C, 60% RH, 2 days). Depending on the type of antioxidant, the solvent used was either water or ethanol. In this manner, a tobacco filler in the form of paper-processed sheet tobacco was prepared. This type of tobacco filler is referred to as "paper-processed sheet tobacco B".

[0201] As a control, a tobacco filler in the form of paper-processed sheet tobacco was prepared in the same manner except that the liquid composition was not sprayed onto the paper-processed sheet tobacco.

d) Slurry-processed Sheet Tobacco

[0202] A raw material slurry was prepared by adding water to fine tobacco powder (burley tobacco : flue-cured tobacco = 7 : 3), a binder, glycerin, and an antioxidant, followed by kneading. The raw material slurry was cast on a heated metal plate and dried while adjusting the thickness (heating temperature: 110 °C, heating time: 10 minutes, moisture content at a start of drying: 400% by mass). In this manner, a tobacco filler in the form of slurry-processed sheet tobacco was prepared.

[0203] As a control, a tobacco filler in the form of slurry-processed sheet tobacco was prepared in the same manner except that no antioxidant was added to the raw material slurry.

[0204] The types and amounts of the antioxidants added are shown in Tables 1 to 3. In Tables 1 to 3, the amounts of the antioxidants added are represented by mass % with respect to the tobacco material (cut tobacco, base sheet made of tobacco residue, or fine tobacco powder).

[1-2. Measurement of Amount of TSNA]

[0205] The heating of the tobacco filler for generating a tobacco vapor was performed using a heating furnace (infrared furnace) that uses infrared lamps as heat sources, or using the heating-type flavor inhaler (product name: Ploom S, JAPAN TOBACCO INC.) shown in FIGS. 7 to 9.

[0206] The term "amount of TSNA" as used herein refers to the total amount of the four components, which are 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), N'-nitrosonomicotine (NNN), N'-nitrosoanatabine (NAT), and N'-nitrosoanabasine (NAB).

<Heating Test 1: Heating with Infrared Furnace>

[0207] An infrared gold image furnace (ADVANCE RIKO, Inc.) was used as an infrared furnace. The tobacco filler

(i.e., a) cut tobacco, b) paper-processed sheet tobacco A, or d) slurry-processed sheet tobacco) in an amount of 0.2 g was filled into a silica glass tube and heated under the heating conditions shown in Tables 1 and 2. The "attained temperature" shown in Tables 1 and 2 is a value obtained by measuring the temperature of the tobacco filler with a thermocouple.

[0208] The amount of TSNA in the tobacco filler before heating and the amount of TSNA in the tobacco vapor released from the tobacco filler during heating were measured.

(Method for Measuring Amount of TSNA in Tobacco Filler)

[0209] The amount of TSNA in the tobacco filler was measured according to an official method (CORESTA METHOD in accordance with CRM72). Specifically, an internal standard solution and 0.1 M ammonium acetate were added to a sample of the tobacco filler, followed by shaking, dilution, and filtration, and the amount of TSNA was measured by UPLC/MS/MS.

(Method for Measuring Amount of TSNA in Tobacco Vapor)

[0210] The amount of TSNA in the tobacco vapor was measured according to an official method (CORESTA METHOD in accordance with CRM75). Specifically, first, a tobacco vapor generated by heating the tobacco filler with the infrared furnace was collected by the glass fiber filter. An internal standard solution and 0.1 M ammonium acetate were added to the glass fiber filter that collected the tobacco vapor, followed by shaking, dilution, and filtration, and the amount of TSNA was measured by HPLC/MS/MS.

<Heating Test 2: Heating with Heating-type Flavor Inhaler>

[0211] The heating-type flavor inhaler (product name: Ploom S, JAPAN TOBACCO INC.) shown in FIGS. 7 to 9 was used as a heating-type flavor inhaler.

[0212] A tobacco stick was prepared using a tobacco filler containing an antioxidant or a tobacco filler containing no antioxidant (control). Specifically, a tobacco stick was prepared by taking out the tobacco material part of the tobacco stick of the Ploom S product (see FIG. 8) and adding 0.26 g of the above-described "paper-processed sheet tobacco B" instead.

(Method for Measuring Amount of TSNA in Tobacco Vapor)

[0213] According to the same procedure as described above, a tobacco vapor released from the tobacco stick was collected, and the amount of TSNA in the tobacco vapor was measured. Seven puffs of tobacco vapor were collected under inhalation conditions corresponding to the Canadian Intensive Regimen (CIR) (i.e., puff volume: 55 mL, puff duration: 2 seconds, puff frequency: 2 times/minute, filter ventilation portion closed: none). During use of the heating-type flavor inhaler, the temperature inside the tobacco stick was about 200 °C.

[1-3. Results]

[0214] For each experiment, a tobacco filler containing an antioxidant and a tobacco filler containing no antioxidant (control) were prepared, and the effect of addition of an antioxidant on the amount of TSNA was examined. The results are shown in Tables 1 to 3.

[Table 1]

Experiment No.	Tobacco filler	Antioxidant		Drying conditions for preparing tobacco filler	Heating conditions		Amount of TSNA [ng/g]	
		Type	Addition amount [Mass %]		Attained temperature [°C]	Isothermal heating time [Second]	Antioxidant Not added	Antioxidant Added
A1	Cut tobacco	Gallic acid	0.9	Conditioned drying	200	360	7997	7154
A2	Cut tobacco	Gallic acid	2.8	Conditioned drying	200	360	7997	5681
A3	Cut tobacco	Gallic acid	4.5	Conditioned drying	200	360	7997	5678
A4	Cut tobacco	Gallic acid	2.8	Conditioned drying	200	360	1847	1561
B1	Cut tobacco	Erythorbic acid	2.8	Conditioned drying	200	360	1664	854
B2	Cut tobacco	Ascorbic acid	2.8	Conditioned drying	200	360	1842	1309
B3	Cut tobacco	Catechin	2.8	Conditioned drying	200	360	1842	1257
B4	Cut tobacco	Gallic acid	2.8	Conditioned drying	200	360	1842	1488
B5	Cut tobacco	P-coumaric acid	2.8	Conditioned drying	200	360	1664	1202
B6	Cut tobacco	Ferulic acid	2.8	Conditioned drying	200	360	1664	1319
B7	Cut tobacco	Quercetin	2.8	Conditioned drying	200	360	1664	1495
B8	Cut tobacco	Caffeic acid	2.8	Conditioned drying	200	360	1842	1615
B9	Cut tobacco	BHT	2.8	Conditioned drying	200	360	1664	1219

(continued)

Experiment No.	Tobacco filler	Antioxidant		Drying conditions for preparing tobacco filler	Heating conditions		Amount of TSNA [ng/g]	
		Type	Addition amount [Mass %]		Attained temperature [°C]	Isothermal heating time [Second]	Antioxidant Not added	Antioxidant Added
B10	Cut tobacco	Quinic acid	2.8	Conditioned drying	200	360	1842	1614
C1	Cut tobacco	Ascorbic acid	0.9	Conditioned drying	200	360	1617	1437
C2	Cut tobacco	Chlorogenic acid	5.4	Conditioned drying	200	360	1398	1167

[Table 2]

Experiment No.	Tobacco filler	Antioxidant		Drying conditions for preparing tobacco filler	Heating conditions		Amount of TSNA [ng/g]	
		Type	Addition amount [Mass %]		Attained temperature [°C]	Isothermal heating time [Second]	Antioxidant Not added	Antioxidant Added
D1	Cut tobacco	Gallic acid	2.8	Conditioned drying	200	360	1919	1414
D2	Cut tobacco	Gallic acid	2.8	Conditioned drying	250	360	3184	2178
D3	Cut tobacco	Gallic acid	2.8	Conditioned drying	300	360	3948	2862
D4	Cut tobacco	Ascorbic acid	2.8	Conditioned drying	200	360	1919	1558
D5	Cut tobacco	Ascorbic acid	2.8	Conditioned drying	250	360	3184	2641
D6	Cut tobacco	Ascorbic acid	2.8	Conditioned drying	300	360	3948	3024
D7	Cut tobacco	Catechin	2.8	Conditioned drying	200	360	1919	1312
D8	Cut tobacco	Catechin	2.8	Conditioned drying	250	360	3184	2056
D9	Cut tobacco	Catechin	2.8	Conditioned drying	300	360	3948	2906
E1	Cut tobacco	Catechin	2.8	Conditioned drying			2010	1931
F1	Paper-processed sheet tobacco A	Gallic acid	0.6	Heat-drying			671	692
					200	360	930	657
F2	Paper-processed sheet tobacco A	Gallic acid	0.6	Heat-drying	300	360	1467	1097
F3	Paper-processed sheet tobacco A	Tocopherol	0.6	Heat-drying	200	360	930	703
F4	Paper-processed sheet tobacco A	Tocopherol	0.6	Heat-drying	300	360	1467	1310
G1	Slurry-processed sheet tobacco	Ascorbic acid	1.8	Heat-drying			1070	1060
					200	270	1510	795
G2	Slurry-processed sheet tobacco	Ascorbic acid	1.8	Heat-drying	260	270	2037	1233

[Table 3]

Experiment No.	Tobacco filler	Antioxidant		Drying conditions for preparing tobacco filler	Inhalation conditions		Amount of TSNA [ng/g]	
		Type	Addition Amount [Mass %]		Inhalation conditions	Number of puffs	Antioxidant Not added	Antioxidant Added
H1	Paper-processed sheet tobacco B	Gallic acid	2.1	Conditioned drying	CIR	7	20.5	16.9
H2	Paper-processed sheet tobacco B	Erythorbic acid	2.1	Conditioned drying	CIR	7	26.4	19.0
H3	Paper-processed sheet tobacco B	Ascorbic acid	2.1	Conditioned drying	CIR	7	28.7	21.4
H4	Paper-processed sheet tobacco B	Catechin	2.1	Conditioned drying	CIR	7	20.5	17.7
H5	Paper-processed sheet tobacco B	Ferulic acid	2.1	Conditioned drying	CIR	7	20.5	18.5
H6	Paper-processed sheet tobacco B	Caffeic acid	2.1	Conditioned drying	CIR	7	28.7	20.7
I1	Paper-processed sheet tobacco B	Erythorbic acid	0.5	Conditioned drying	CIR	7	22.1	19.4
I2	Paper-processed sheet tobacco B	Erythorbic acid	1.0	Conditioned drying	CIR	7	22.1	16.9
I3	Paper-processed sheet tobacco B	Erythorbic acid	0.25	Conditioned drying	CIR	7	28.7	25.1

[0215] In Tables 1 to 3, the amount of TSNA is represented by the mass of TSNA per 1 g mass of the tobacco filler [ng/g]. In Tables 1 to 3, the amount og TSNA shown in the row where the "heating condition" or the "inhalation condition" is specified represents the amount of TSNA in the tobacco vapor, and the amount of TSNA shown in the row where the "heating condition" or the "inhalation condition" is not specified reperesents the amount of TSNA in the tobacco filler before heating with the heating- type flavor inhaler.

<Experiments A1 to A4>

[0216] In Experiments A1 to A4, the amount of the antioxidant added was varied as shown in Table 1. As the tobacco material, burley cut tobacco from the U.S. was used in Experiments A1 to A3, and burley cut tobacco from Malawi was used in Experiment A4.

[0217] Adding the antioxidant successfully reduced the amount of TSNA in the tobacco vapor. Also, increasing the amount of the antioxidant added successfully improved the effect of reducing the amount of TSNA.

<Experiments B1 to B10>

[0218] In Experiments B1 to B10, the type of antioxidant was varied as shown in Table 1. Burley cut tobacco from Malawi was used in Experiments B1 to B10.

[0219] All of the antioxidants used successfully reduced the amount of TSNA in the tobacco vapor. Gallic acid or erythorbic acid is particularly preferred because a sufficient effect of reducing the amount of TSNA is achieved and the influence of the antioxidants on the smoking flavor is small.

[0220] There was a variation in the amount of TSNA in the control tobacco fillers because the batches were different.

<Experiments C1 to C2>

[0221] In Experiments C1 to C2, burley cut tobacco from Malawi was used, and the amount of the antioxidant added was varied as shown in Table 1.

[0222] Both the case where the amount of the antioxidant added was 0.9% by mass with respect to the tobacco material (cut tobacco) and the case where the amount of the antioxidant added was 5.4% by mass with respect to the tobacco material (cut tobacco) successfully reduced the amount of TSNA in the tobacco vapor. Both this result and the results of Experiments A1 to A4 demonstrate that increasing the amount of the antioxidant added tends to improve the effect of reducing the amount of TSNA, but that increasing the amount of the antioxidant added to a certain level decreases the improvement rate of the effect. Therefore, the amount of the antioxidant added is preferably 10% by mass or less with respect to the tobacco material in consideration of the cost-effectiveness and the influence on the smoking flavor.

<Experiments D1 to D9>

[0223] In Experiments D1 to D9, the heating temperature during inhalation was varied as shown in Table 2.

[0224] All of the antioxidants used successfully reduced the amount of TSNA in the tobacco vapor in the temperature range of 200 to 300 °C. This temperature range is a temperature range used for heating a tobacco filler in a general heating-type flavor inhaler. Therefore, this result demonstrates that the tobacco filler according to the present invention is suitable for use in a general heating-type flavor inhaler, such as a heating-type flavor inhaler that heats a tobacco filler to a temperature of 150 °C or higher.

<Experiment E1>

[0225] In Experiment E1, a tobacco filler containing an antioxidant (catechin) and a tobacco filler containing no antioxidant (catechin) were prepared, and the obtained tobacco fillers were stored in a conditioned room (22 °C, 60% RH) for 4 months. After storage, the amounts of TSNA in the tobacco fillers were measured.

[0226] There was no significant difference in the amount of TSNA in the tobacco fillers between the tobacco filler containing an antioxidant and the tobacco filler containing no antioxidant. This result shows that the antioxidant in the tobacco filler in the form of cut tobacco does not exhibit the effect of reducing the amount of TSNA until the user uses the heating-type flavor inhaler.

<Experiments F1 to F4>

[0227] In Experiments F1 to F4, the effect of reducing the amount of TSNA in paper-processed sheet tobacco was examined.

[0228] In the paper-processed sheet tobacco as well, adding an antioxidant successfully reduced the amount of TSNA in the tobacco vapor. Also, a sufficient effect was obtained even when the antioxidant was added in an amount of 0.6% by mass with respect to the base sheet made of tobacco residue.

[0229] In Experiment F1, a tobacco filler containing an antioxidant (gallic acid) and a tobacco filler containing no antioxidant (gallic acid) were prepared, and the obtained tobacco fillers were stored in a conditioned room (22 °C, 60% RH) for 4 months. After storage, the amounts of TSNA in the tobacco fillers were measured.

[0230] There was no significant difference in the amount of TSNA in the tobacco fillers between the tobacco filler containing an antioxidant and the tobacco filler containing no antioxidant. This result shows that the antioxidant in the tobacco filler in the form of paper-processed sheet tobacco does not exhibit the effect of reducing the amount of TSNA until the user uses the heating-type flavor inhaler.

<Experiments G1 to G2>

[0231] In Experiment G1, the effect of reducing the amount of TSNA in slurry-processed sheet tobacco was examined.

[0232] In the slurry-processed sheet tobacco as well, adding an antioxidant successfully reduced the amount of TSNA in the tobacco vapor. The results of this experiment and Experiments F1 to F4 demonstrate that the same effect of reducing the amount of TSNA is obtained not only in cut tobacco but also in a tobacco molded body such as sheet tobacco.

[0233] In Experiment G1, a tobacco filler containing an antioxidant (ascorbic acid) and a tobacco filler containing no antioxidant (ascorbic acid) were prepared, and the obtained tobacco fillers were stored in a conditioned room (22 °C, 60% RH) for 4 months. After storage, the amounts of TSNA in the tobacco fillers were measured.

[0234] There was no significant difference in the amount of TSNA in the tobacco fillers between the tobacco filler containing an antioxidant and the tobacco filler containing no antioxidant. This result shows that the antioxidant in the tobacco filler in the form of slurry-processed sheet tobacco does not exhibit the effect of reducing the amount of TSNA until the user uses the heating-type flavor inhaler.

<Experiments H1 to H6>

[0235] In the above experiments, the tobacco fillers were heated by an infrared furnace; however, in the following experiments, tobacco fillers were incorporated into a tobacco stick and heated by a heating-type flavor inhaler. When the tobacco fillers were actually heated by a heating-type flavor inhaler, the amount of TSNA in the tobacco vapor was also successfully reduced as in the case where the tobacco fillers were heated by an infrared furnace.

[0236] In Experiments H1 to H6, the type of antioxidant was varied as shown in Table 3. All of the antioxidants used successfully reduced the amount of TSNA in the tobacco vapor.

<Experiments I1 to I3>

[0237] In Experiments I1 to I3 as well, tobacco fillers were incorporated into a tobacco stick and heated by a heating-type flavor inhaler. In Experiments I1 to I3, the amount of the antioxidant added was varied as shown in Table 3.

[0238] The effect of reducing the amount of TSNA was obtained even when the antioxidant was added in an amount of 0.25% by mass with respect to the base sheet made of tobacco residue. The results of this experiment, Experiments A1 to A4, and Experiments C1 to C2 demonstrate that the amount of the antioxidant added is preferably 0.25% by mass or more with respect to the tobacco material.

[Example 2]

[0239] In Example 2, the effect of the drying conditions for preparation of a tobacco filler on the amount of TSNA contained in the tobacco filler was evaluated.

[2-1. Preparation of Tobacco Filler]

[0240] A tobacco filler containing an antioxidant (gallic acid) and a tobacco filler containing no antioxidant (gallic acid) were prepared as described below.

[0241] Slurry S1 and S2 were prepared by blending the materials shown in Table 4 below at the blending ratios (parts by mass) shown in the table, and stirring and mixing them together for 30 minutes using a mechanical stirrer.

[Table 4]

	Fine tobacco powder	Glycerin	Binder (Guar gum)	Conifer pulp	Gallic acid	Water
Slurry S1	80	15	2	3	0	400
Slurry S2	79	15	2	3	1	400

[0242] Additionally, slurry S3 and S4 were prepared as follows. Slurry S3 was prepared by taking slurry S1, adding water thereto in an amount corresponding to 40% by mass of slurry S1, and stirring and mixing them together using a mechanical stirrer. Likewise, slurry S4 was prepared by taking slurry S2, adding water thereto in an amount corresponding to 40% by mass of slurry S2, and stirring and mixing them together using a mechanical stirrer.

[0243] Slurries S1 to S4 were each cast on a resin-made thin film sheet "NITOFLON" (Nitto Denko Corporation) using an applicator. Then, the slurry on the thin film sheet was heat-dried by being left to stand on a stainless steel plate heated in advance to a predetermined temperature in a drying oven. Sheet tobacco was thus prepared.

[0244] The type of slurry used and the heat-drying conditions are shown in the table below.

[Table 5]

Experiment No.	Slurry	Drying temperature [°C]	Drying time [Minute]	Moisture content [%DB]
J1	S1	110 °C	10	400
	S2	110 °C	10	400
J2	S1	120 °C	10	400
	S2	120 °C	10	400
J3	S1	110 °C	15	400
	S2	110 °C	15	400
J4	S3	110 °C	10	600
	S4	110 °C	10	600

[0245] The "moisture content" refers to a value represented by the following formula:

$$\text{Moisture content [\% by mass]} = (\text{mass of added water in tobacco mixture} / \text{total mass of tobacco material and additive in tobacco mixture}) \times 100$$

[0246] The prepared sheet tobacco was moisture-conditioned for 48 hours under conditioning conditions (22 °C, 60% RH), and then each sheet of sheet tobacco was peeled off from the thin film sheet and ground with a mill to prepare a ground product of sheet tobacco.

[2-2. Measurement of Amount of TSNA]

[0247] The amount of TSNA in the ground product of sheet tobacco prepared was measured according to an official method (CORESTA METHOD in accordance with CRM72). The analysis was repeated twice and the average value was calculated.

[2-3. Results]

[0248] Table 6 shows the results of measuring the amount of TSNA.

[Table 6]

Experiment No.	Drying temperature [°C]	Drying time [Minute]	Moisture content [%DB]	Amount of TSNA [ng/g]		Ratio of amounts of TSNA [Antioxidant added / No antioxidant added]
				No antioxidant added	Antioxidant added	
J1	110	10	400	3686	3669	1.00
J2	120	10	400	4243	3913	0.92
J3	110	is	400	3764	3512	0.93
J4	110	10	600	3608	3482	0.97

[0249] In Table 6, the amount of TSNA in the tobacco filler is represented by the mass of TSNA per 1 g mass of the tobacco filler [ng/g].

[0250] In Experiment J1, heat-drying was performed under the conditions of a drying temperature of 110 °C, a drying time of 10 minutes, and a moisture content of 400% when preparing a tobacco filler. With the heat-drying under these conditions, the addition of the antioxidant did not reduce the amount of TSNA in the tobacco filler. This result shows that the amount of TSNA in the tobacco filler did not decrease because the antioxidant did not react with the nitrite derived from the tobacco material (fine tobacco powder) during heat-drying.

[0251] On the other hand, in Experiment 12, heat-drying was performed under the conditions of a drying temperature of 120 °C, a drying time of 10 minutes, and a moisture content of 400% when preparing a tobacco filler. In Experiment 13, heat-drying was performed under the conditions of a drying temperature of 110 °C, a drying time of 15 minutes, and a moisture content of 400% for preparing a tobacco filler. In Experiment J4, heat-drying was performed under the conditions of a drying temperature of 110 °C, a drying time of 10 minutes, and a moisture content of 600% when preparing a tobacco filler. With the heat-drying under these conditions, the addition of the antioxidant reduced the amount of TSNA in the tobacco filler. These results show that the amount of TSNA in the tobacco filler decreased because the antioxidant reacted with the nitrite derived from the tobacco material (fine tobacco powder) during heat-drying.

[0252] The above results demonstrate the following. If the drying for preparing a tobacco filler is performed by heat-drying under conditions of

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of drying, or

by allowing the tobacco mixture to stand at room temperature without heating, the added antioxidant hardly reacts with the nitrite derived from the tobacco material during drying, and the antioxidant can remain in the tobacco filler.

[Example 3]

[0253] In Example 3, the influence of addition of an antioxidant on a smoking flavor was evaluated.

[3-1. Preparation of Tobacco Stick]

[0254] A tobacco stick including a tobacco filler containing an antioxidant and a tobacco stick including a tobacco filler containing no antioxidant were prepared as described below.

(1) Tobacco Stick Including Tobacco Filler Containing Antioxidant

[0255] A tobacco material part of a tobacco stick of Ploom S product (MEVIUS REGULAR TASTE for Ploom S, JAPAN TOBACCO INC.) was taken out, sprayed with a liquid composition containing an antioxidant and a solvent, and subjected to conditioned drying (22 °C, 60% RH, 2 days). Depending on the type of antioxidant, the solvent used was either water or ethanol. The obtained tobacco filler was returned to the original tobacco stick to prepare a tobacco stick (1).

[0256] Either erythorbic acid, gallic acid, catechin, or ascorbic acid was used as the antioxidant.

(2) Tobacco Stick Including Tobacco Filler Containing No Antioxidant

[0257] A tobacco stick of Ploom S product (MEVIUS REGULAR TASTE for Ploom S, JAPAN TOBACCO INC.) was used as a tobacco stick (2).

[3-2. Sensory Evaluation]

[0258] A sensory evaluation was performed by a panel of five in-house experts. Specifically, the tobacco sticks (1) and (2) were smoked using a Ploom S device (see FIG. 9), and the smoking flavors were compared between the tobacco stick (1) and the tobacco stick (2).

[3-3. Results]

[0259] The results are shown in Table 7.

[Table 7]

Antioxidant	Addition concentration (Mass %)	Influence on smoking flavor
Erythorbic acid	2.1	None
Gallic acid	2.1	None
Catechin	2.1	None
Ascorbic acid	2.1	None

[0260] No noticeable off-flavor or irritation was felt in any of the tobacco sticks. In addition, the tobacco stick (1) containing the antioxidant was felt to have a smoother smoking flavor as a whole, but the smoking flavor was not apparently impaired by the addition of the antioxidant.

Claims

1. A tobacco filler comprising:

a tobacco material; and
an antioxidant in an amount of 0.25% by mass or more with respect to the tobacco material.

2. The tobacco filler according to claim 1, wherein the tobacco filler is in a form of a tobacco molded body.

3. The tobacco filler according to claim 1 or 2, wherein the tobacco filler is in a form of sheet tobacco.

4. The tobacco filler according to any one of claims 1 to 3, wherein the antioxidant is at least one selected from the group consisting of gallic acid and erythorbic acid.

5. The tobacco filler according to any one of claims 1 to 4, wherein an amount of the antioxidant is 10% by mass or less with respect to the tobacco material.

6. A heat-not-burn-type flavor inhaler comprising a flavor source including the tobacco filler according to any one of claims 1 to 5.

7. A method for producing a tobacco filler, the method comprising:

adding an antioxidant and a liquid to a tobacco material to prepare a tobacco mixture; and
drying the tobacco mixture to prepare a tobacco filler; and
maintaining the tobacco mixture and the tobacco filler under a condition for suppressing a reaction between the antioxidant and nitrite derived from the tobacco material until incorporation of the tobacco filler into a heat-not-burn-type flavor inhaler is completed.

8. The method according to claim 7, wherein the maintaining is achieved by performing the drying of the tobacco mixture under conditions of:

(a) a heating temperature of 110 °C or lower;
(b) a heating time of 10 minutes or less; and
(c) a moisture content of 400% by mass or less at a start of the drying.

9. The method according to claim 7, wherein the maintaining is achieved by allowing the tobacco mixture to stand under conditions of a temperature of 7 to 40 °C and a relative humidity of 40 to 80%.

10. The method according to any one of claims 7 to 9, wherein the tobacco filler is in a form of a tobacco molded body.

11. The method according to any one of claims 7 to 10, wherein the tobacco filler is in a form of sheet tobacco.

12. The method according to any one of claims 7 to 11, wherein the antioxidant is at least one selected from the group consisting of gallic acid and erythorbic acid.

13. The method according to any one of claims 7 to 12, wherein an amount of the antioxidant is 0.25% by mass or more with respect to the tobacco material.

14. The method according to any one of claims 7 to 13, wherein an amount of the antioxidant is 10% by mass or less with respect to the tobacco material.

15. A tobacco filler obtainable by the method according to any one of claims 7 to 14.

16. A heat-not-burn-type flavor inhaler comprising a flavor source including the tobacco filler according to claim 15.

17. The heat-not-burn-type flavor inhaler according to claim 6 or 16, wherein the flavor source is heated to a temperature of 150 °C or higher.

18. The heat-not-burn-type flavor inhaler according any one of claims 6, 16 and 17, further comprising a heater for heating the flavor source.

19. The heat-not-burn-type flavor inhaler according to any one of claims 6 and 16 to 18, comprising:

a tobacco stick including the flavor source and cigarette paper wrapped around the flavor source; and
a heater for heating the tobacco stick.

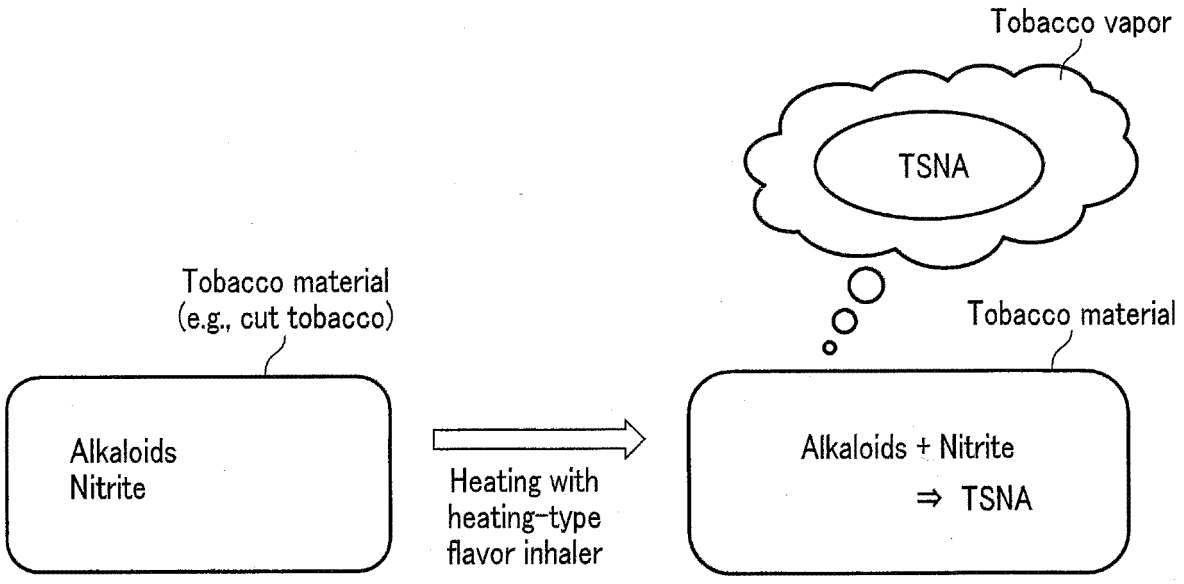
Tobacco vapor
TSNA
Tobacco material
(e.g., cut tobacco)
Tobacco material
Alkaloids
Nitrite
Heating with
heating-type
flavor inhaler
Alkaloids + Nitrite
⇒ TSNA

FIG. 1

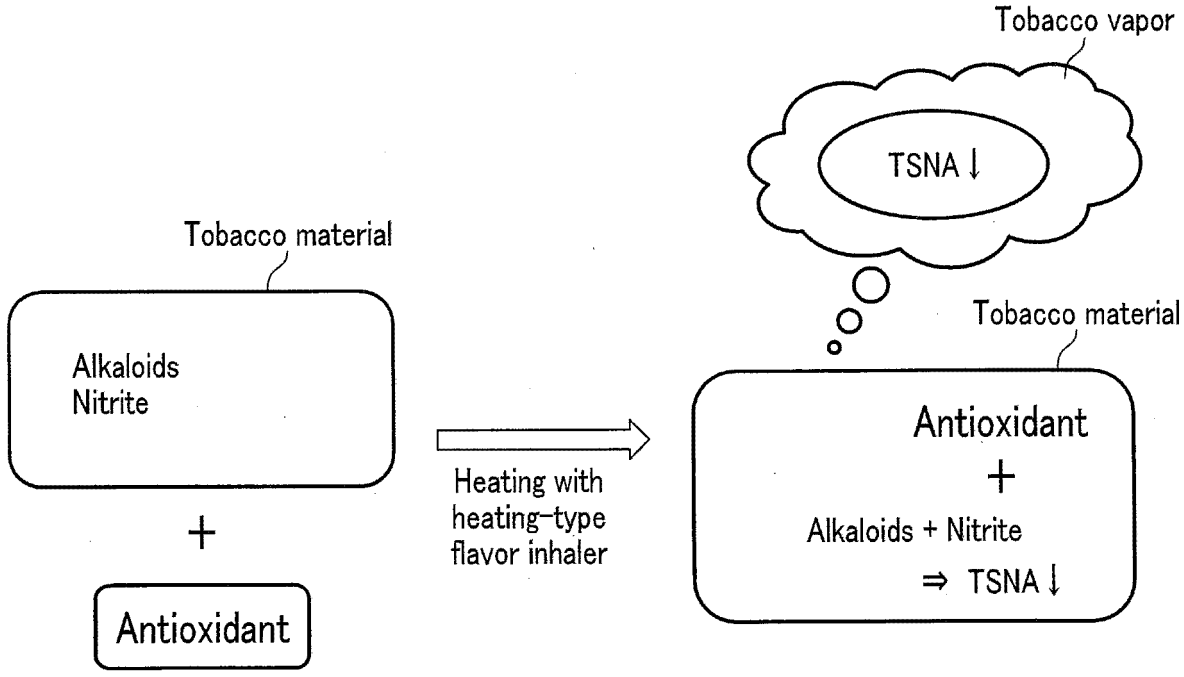
Tobacco vapor
TSNA ↓
Tobacco material
Tobacco material
Alkaloids
Nitrite
+
Antioxidant
Heating with
heating-type
flavor inhaler
Antioxidant
+
Alkaloids + Nitrite
⇒ TSNA ↓

FIG. 2

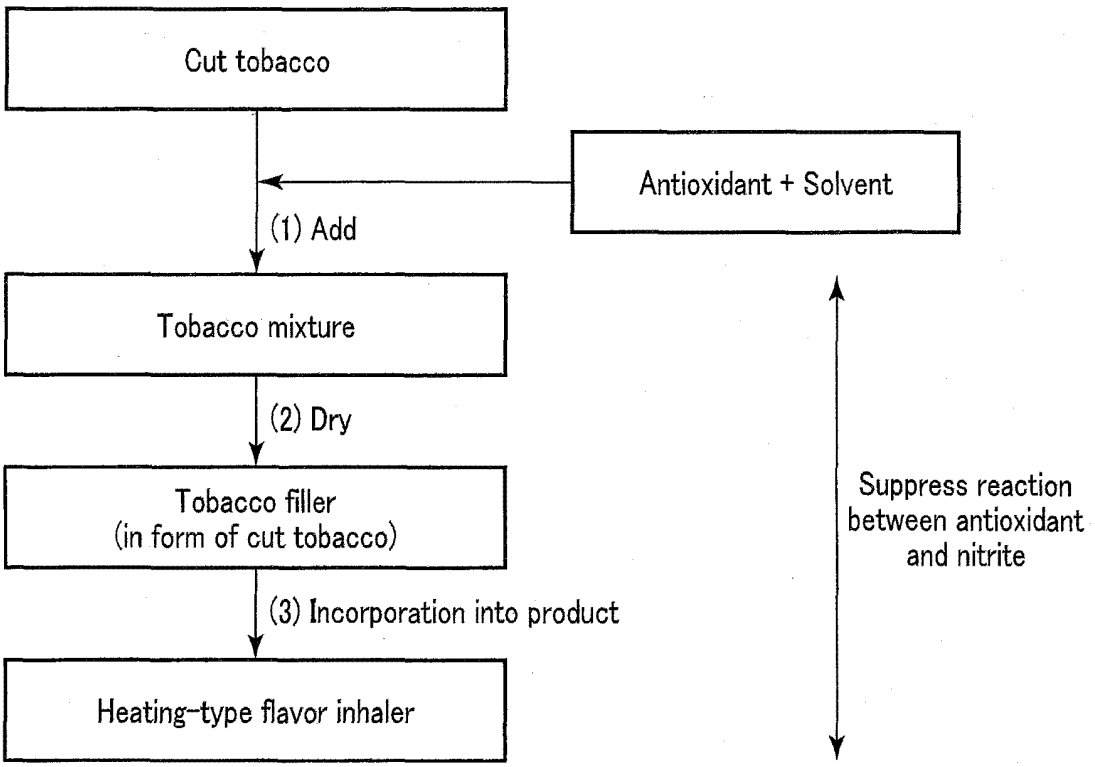
Cut tobacco
Antioxidant + Solvent
(1) Add
Tobacco mixture
(2) Dry
Tobacco filler
(in form of cut tobacco)
(3) Incorporation into product
Heating-type flavor inhaler
Suppress reaction between antioxidant and nitrite

FIG. 3

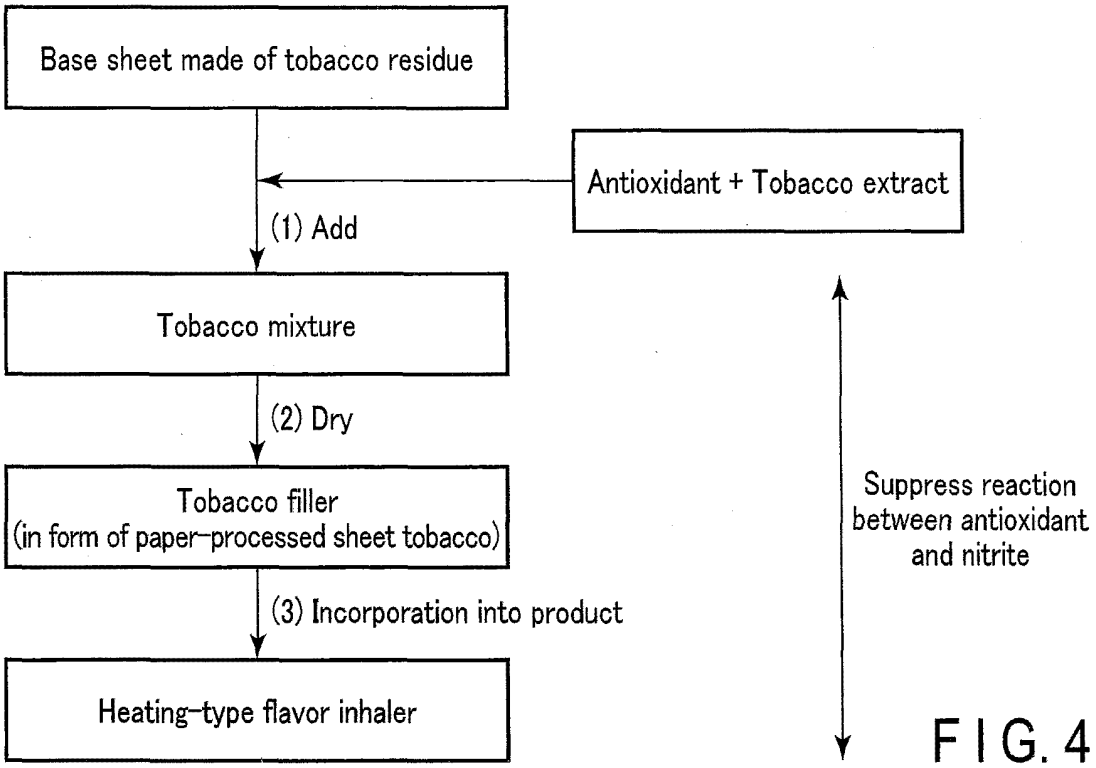
Base sheet made of tobacco residue
Antioxidant + Tobacco extract
(1) Add
Tobacco mixture
(2) Dry
Tobacco filler
(in form of paper-processed sheet tobacco)
(3) Incorporation into product
Heating-type flavor inhaler
Suppress reaction between antioxidant and nitrite

FIG. 4

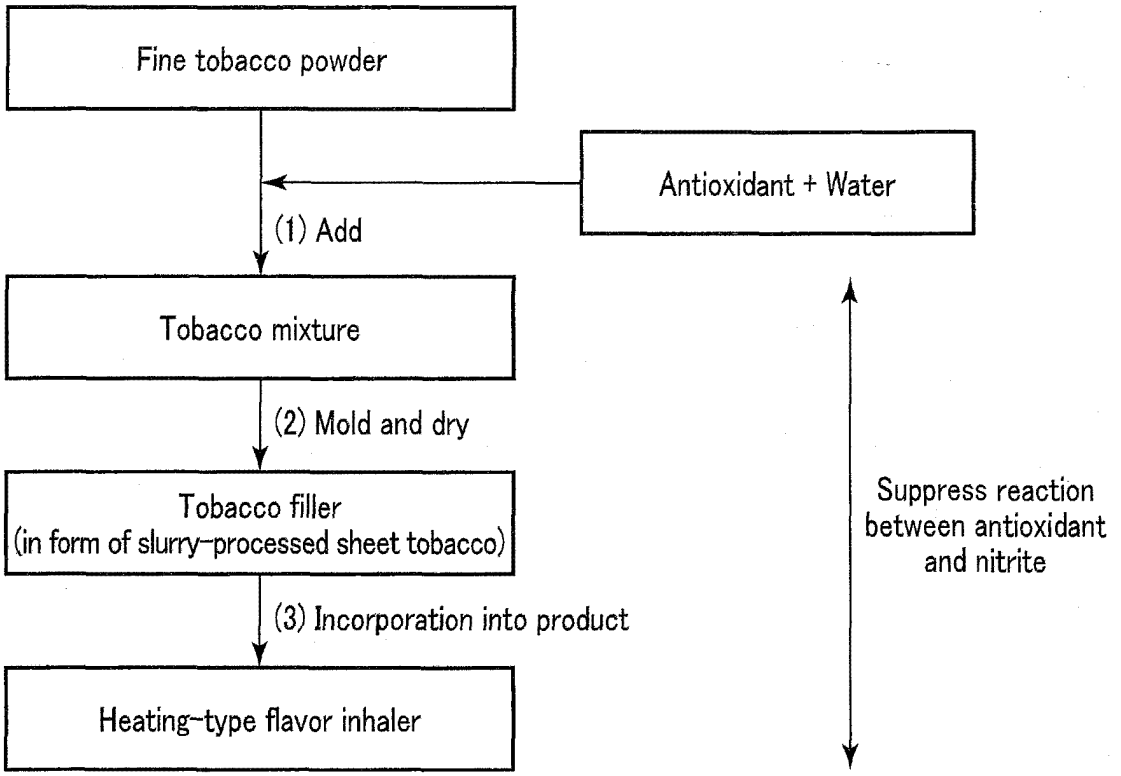
Fine tobacco powder
Antioxidant + Water
(1) Add
Tobacco mixture
(2) Mold and dry
Tobacco filler
(in form of slurry-processed sheet tobacco)
(3) Incorporation into product
Heating-type flavor inhaler
Suppress reaction between antioxidant and nitrite

FIG. 5

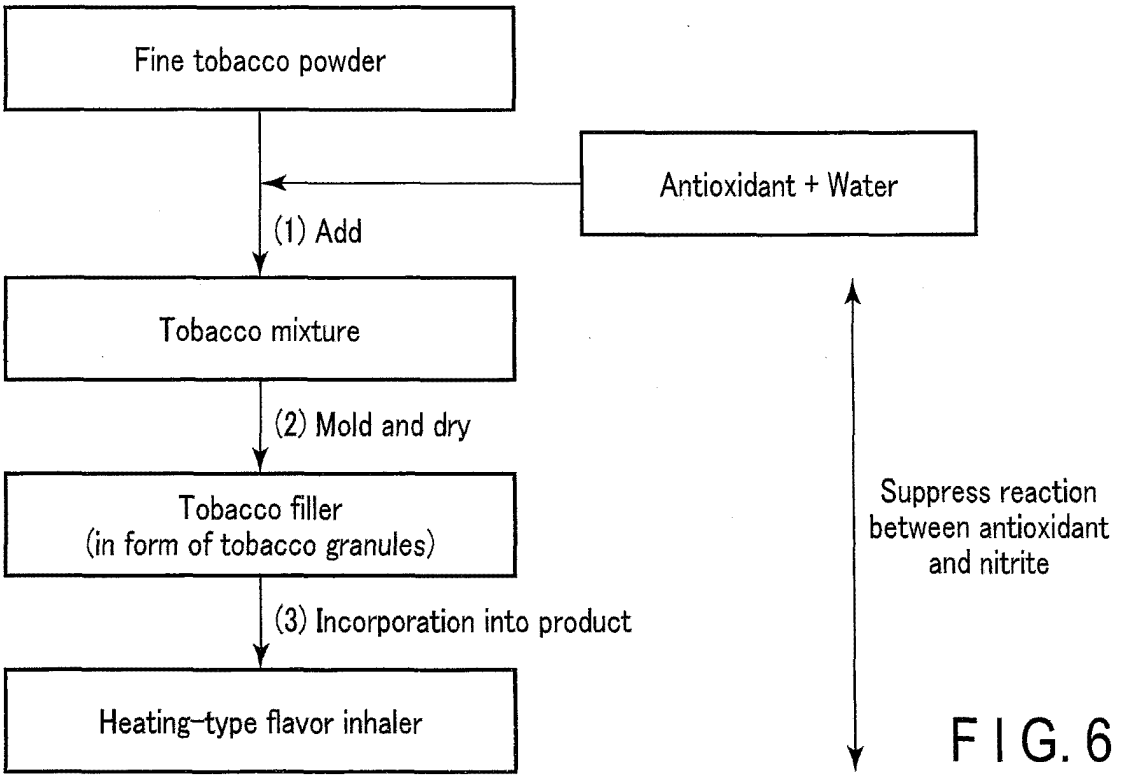
Fine tobacco powder
Antioxidant + Water
(1) Add
Tobacco mixture
(2) Mold and dry
Tobacco filler
(in form of tobacco granules)
(3) Incorporation into product
Heating-type flavor inhaler
Suppress reaction between antioxidant and nitrite

FIG. 6

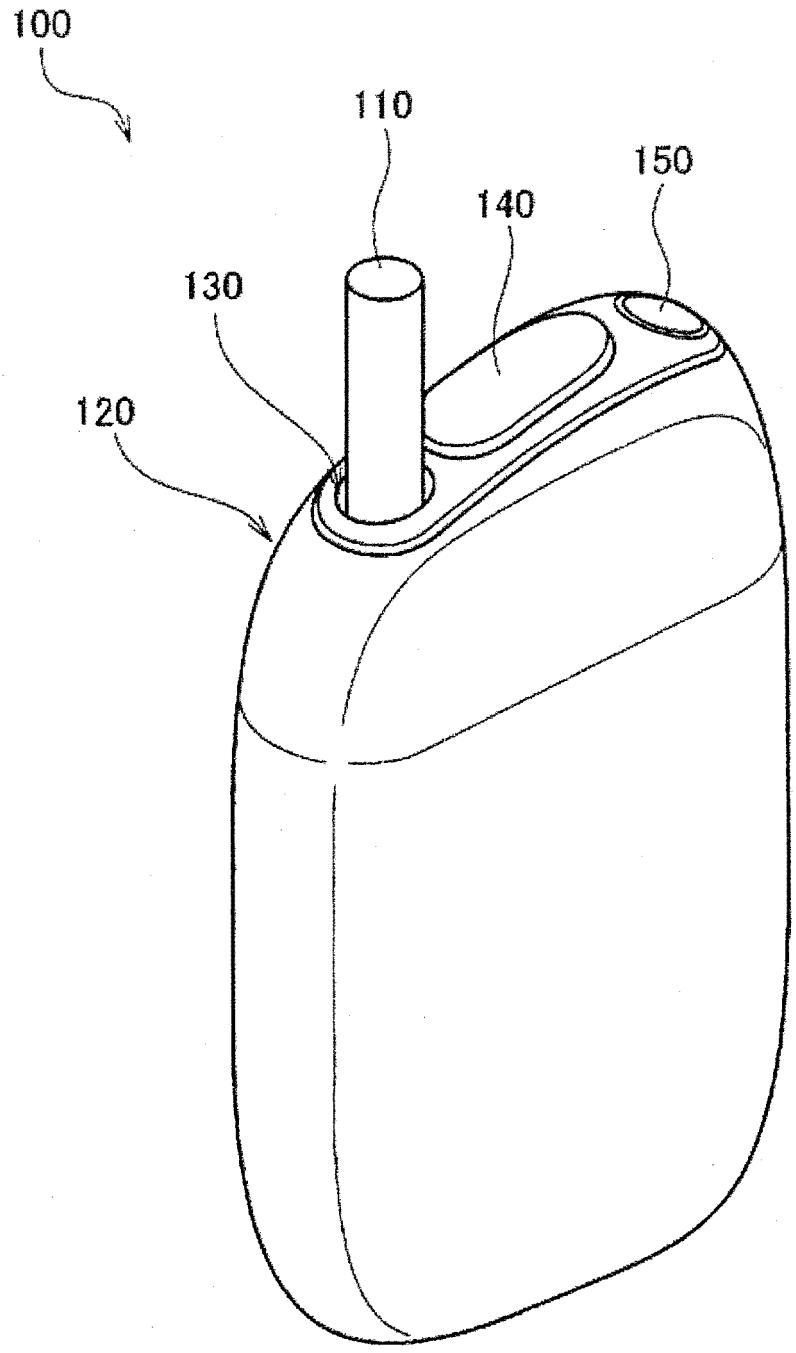

FIG. 7

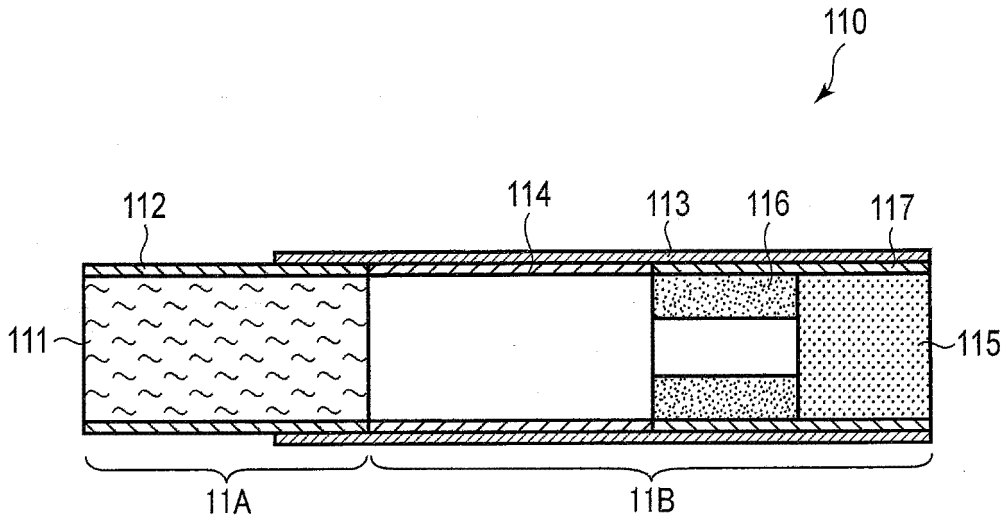

FIG. 8

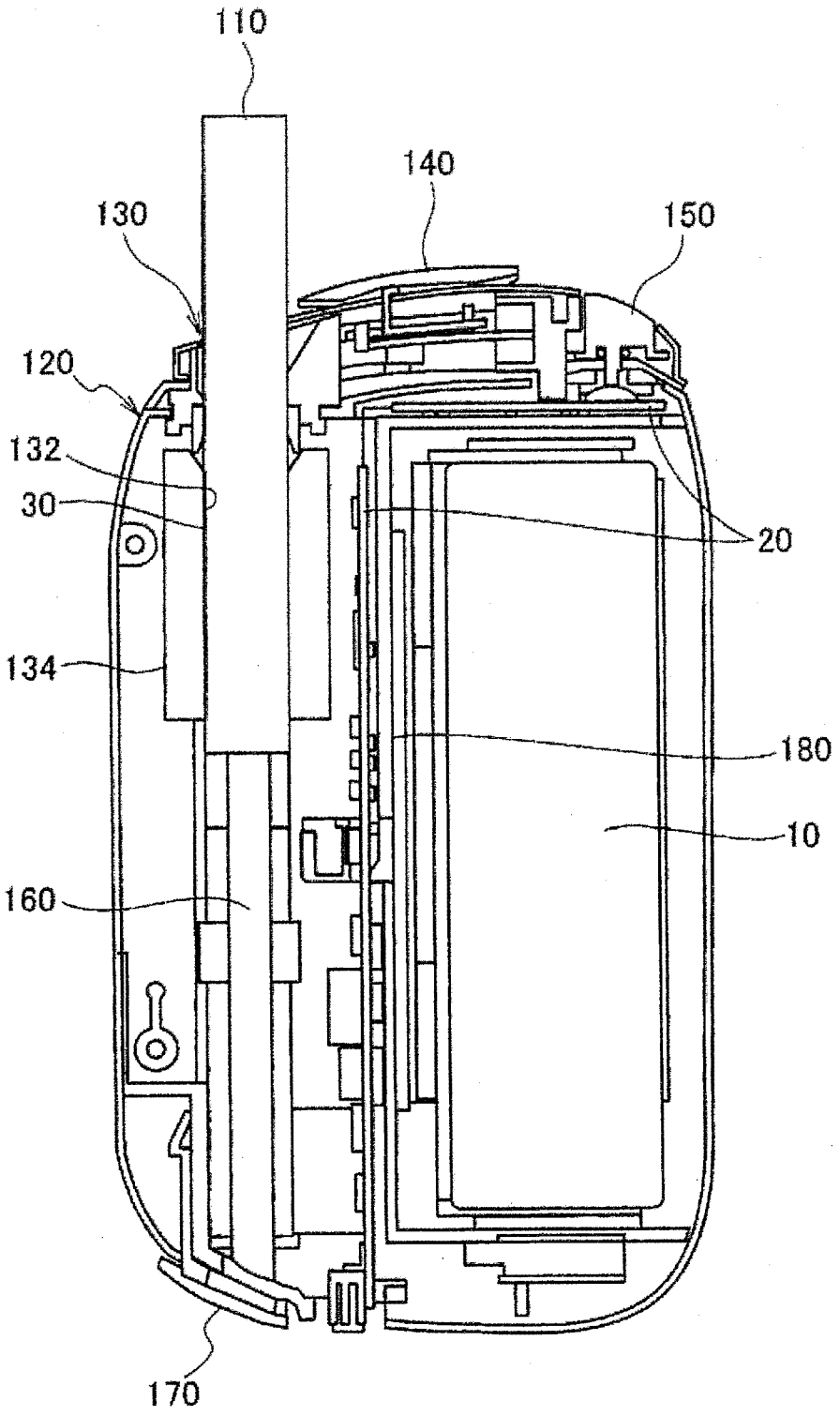

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/033467

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. A24D1/20(2020.01)i, A24F47/00(2020.01)i
FI: A24D1/20, A24F47/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. A24D1/20, A24F47/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2020
Registered utility model specifications of Japan 1996-2020
Published registered utility model applications of Japan 1994-2020

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2003-310234 A (MUROTA, Wataru) 05 November 2003, paragraphs [0001]-[0025], [0029]-[0031], paragraphs [0001]-[0025], [0029]-[0031]	1, 5 2-4, 6-19
Y	JP 2001-516771 A (THIONE INTERNATIONAL, INC.) 02 October 2001, paragraphs [0001]-[0040]	2-4, 6-19
Y	JP 2002-238536 A (MARINE BIO KK) 27 August 2002, paragraphs [0002]-[0007], [0015], [0030]-[0045]	4, 6, 12, 16-19
Y	JP 58-141775 A (SUNTORY LTD.) 23 August 1983, p. 1, lower right column, line 10 to p. 2, lower right column, line 4	4, 6, 12, 16-19

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16.10.2020	27.10.2020
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/033467

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2020-522274 A (PHILIP MORRIS PRODUCTS S.A.) 30 July 2020, paragraphs [0002]-[0005], [0253], fig. 1-3	6, 16-19
A	JP 2006-524494 A (HON, Lik) 02 November 2006, entire text, all drawings	1-19
A	JP 2013-530686 A (GLOBAL VAPOR TRADEMARKS INC.) 01 August 2013, entire text, all drawings	1-19
A	US 2003/0031630 A1 (REZNICK ABRAHAM Z.) 13 February 2003, entire text, all drawings	1-19

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/033467

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 2003-310234 A	05.11.2003	(Family: none)	
JP 2001-516771 A	02.10.2001	US 5829449 A column 1, line 1 to column 9, line 62 WO 1999/015035 A1	
JP 2002-238536 A	27.08.2002	(Family: none)	
JP 58-141775 A	23.08.1983	EP 86638 A2 p. 1, line 8 to p. 3, line 32	
JP 2020-522274 A	30.07.2020	WO 2018/224677 A2 p. 1, line 13 to p. 2, line 10, p. 34, lines 19-28, fig. 1-3	
JP 2006-524494 A	02.11.2006	US 2006/0196518 A1 entire text, all drawings CN 1541577 A	
JP 2013-530686 A	01.08.2013	US 2012/0145170 A1 entire text, all drawings WO 2011/146264 A2	
US 2003/0031630 A1	13.02.2003	WO 2003/000172 A2	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2006073065 A **[0111]**
- WO 2010110226 A **[0111]**
- WO 2015046385 A **[0111]**

Non-patent literature cited in the description

- **HOFFMANN D. et al.** Origin in tobacco smoke of N'-nitrosonomicotine, a tobacco-specific carcinogen: Brief Communication. *J. Natl. Cancer Inst.,* 1977, vol. 58 (6), 1841-1844 **[0006]**
- **ADAMS J. D. et al.** On the formation of the tobacco-specific carcinogen 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone during smoking. *Cancer Lett.,* 1983, vol. 17 (3), 339-346 **[0006]**
- **LIPOWICZ P. J. ; SEEMAN J. I.** A model to estimate the sources of tobacco-specific nitrosamines in cigarette smoke. *Chem. Res. Toxicol.,* 2017, vol. 30 (8), 1556-1561 **[0006]**
- **JACCARD G. et al.** Investigation and comparison of the transfer of TSNA from tobacco to cigarette mainstream smoke and to the aerosol of a heated tobacco product, THS2.2. *Reg. Toxicol. Pharmacol.,* 2018, vol. 97, 103-109 **[0006]**