A method for preserving foodstuffs, in which the foodstuffs are heated in the moist state in a container suitable for transport and storage with ventilation openings. The foodstuffs are heated for a defined period by a microwave, for at least such a time as hot steam forms in the container and exits through the ventilation openings. Gas is injected into the container after the heating process for at least partial compensation of the pressure drop in the container.
METHOD FOR PRESERVING FOODSTUFFS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a National Stage application of International Application No. PCT/CH2006/000063, filed on Feb. 1, 2006, which claims priority of Swiss application number 00219/05, filed on Feb. 10, 2005.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a method for stabilizing foods and in particular pasteurizing foods in which the foods in a moist state inside a container suitable as a shipping and retail package and having a vent opening are heated by microwaves for a limited period of time but at least long enough so that hot steam forms in the container and escapes through the vent opening.

[0004] For further use for shipping and retail, the vent opening of the container must be sealed, even if it is very small, to prevent contamination of the foodstuffs with microorganisms and possibly even leakage of fluid out of the container.

[0005] 2. Description of the Prior Art

[0006] A method of the aforementioned type is known from WO 2004/045985 A1, for example. In this method, a container having a flexible bottom and a flexible cover film is used, with a valve being arranged in it as a vent opening. The valve opens automatically during heating under the influence of the excess pressure generated in the container and thereby allows steam to escape. Even shortly after heating, with the onset of cooling and the resulting drop in pressure, the valve automatically closes again. Subsequently, there is a further drastic drop in pressure with further cooling and due to the condensation of the vapor which practically creates a vacuum in the container. The flexible bottom and the flexible cover film of the container bulge inward under the influence of the vacuum and thereby securely enclose the foodstuffs present in the container between them.

[0007] The same effect is utilized as described in WO 00/036605 A1 and in WO 03/087993 A1 to achieve a tight and secure sheathing of the foodstuffs with an especially flexible cover film.

[0008] EP 1076 012 A1 describes a preparation method for foods in which the foodstuffs in a moist state are heated with microwaves in a container with a partially flexible cover film and an excess pressure valve for a limited period of time, but at least long enough until steam forms in the container and escapes through an excess pressure valve. This known method is available and is suitable in particular for bringing foods in a raw fresh state on the market in a container and only preparing them in the container in a microwave oven by the end user immediately before consuming them. Due to microwave steam preparation under elevated pressure, the foodstuffs are prepared in an extremely gentle manner from their raw state within only a few minutes, whereby their nutritional content, their consistency, color and natural taste are largely preserved.

[0009] However, as part of this usage, it would be unfavorable for a vacuum to develop in the container as described above. The foodstuffs which have just been prepared freshly would be crushed by the covering film bulging inward and liquid might also be pressed out of them. This would destroy the very attractive appearance of the foodstuffs, which has just been achieved. Furthermore, the container as such would be deformed in an unattractive manner. EP 1076 012 A1 solves this problem by a special design of the excess pressure valve. The valve is altered during the heating process so that it can no longer close again or at least can no longer close immediately. This prevents the development of a vacuum in the container. The destruction of the valve in the method according to EP 1076 012 A1 does not constitute a problem because the foodstuffs here are intended for consumption immediately after being prepared. The container is also designed only for a single use and then is no longer needed. To render the foodstuffs stable through heating at the manufacturer’s before the shipping and retail phase, the method according to EP 1076 012 A1 would not be suitable, however, because of the excess pressure valve being destroyed there.

[0010] To at least partially avoid the vacuum problem, EP 1359 097 A1 proposes that in a corresponding method, the microwave treatment in pasteurization should be of such dimensions that the resulting vacuum is no longer great enough to destroy or completely deform the container. In practice, however, this means that for effective pasteurization at a lower temperature, heating must be continued for a longer period of time than in EP 1076 012 A1 by a factor of at least 10, so that the advantages achieved with the preparation method according to EP 1076 012 A1 and through the short preparation times would be virtually lost again completely.

[0011] Patches are also known in which a vent opening without a valve is actively closed again after heating, e.g., with an adhesive patch. In this case, the sealing of the container could basically wait until the container and the foods have cooled sufficiently and an equalization of pressure through the vent opening has been established. However, the time required for this would be substantial and would be a burden on an effective production rate. Due to the air flowing into the container during this pressure equalization phase, microorganisms could also enter the container and impair the stability of the foodstuffs. To have the equalization of pressure performed under a sterile protective gas atmosphere would at the very least be complex in terms of equipment.

[0012] It is possible to provide for the foodstuffs to be heated again by the end user before the foods are consumed and again for this to be done in the container, optionally with the use of microwave heating. Since the foodstuffs have at least partially been pre-prepared through the prior heating to make them stable and/or pasteurize them, simply warming them here is usually sufficient. In this context we also speak of regeneration in contrast with preparation from the raw state. However an excess pressure situation might nevertheless also develop in the container. If there is a valve that opens automatically, it may play a role in pressure release. If a vent opening has been sealed again with an adhesive patch after stabilizing the contents, then an automatic pressure release may no longer be available. Accordingly, the end user is often required to puncture the container before heating it, for example, or expose the sealed vent opening again, e.g., by removing the adhesive patch applied to it. However, adhesive patches which become detached with heating and thereby automatically release the vent opening again have already become known.

[0013] Finally, EP 1359 097 A1 also cites in the introduction other methods of the state of the art, including heating containers without a vent opening under backpressure, but
they are not very economical and they require complicated and expensive plant technology.

SUMMARY OF THE PRESENT INVENTION

[0014] The object of the present invention is to provide a method of stabilizing and in particular pasteurizing foodstuffs of the type defined in the introduction with which the advantages of the preparation method known from EP 1 076 012 A1 can also be achieved by the manufacturer and thus also prior to the shipping and retail phases.

[0015] This object is achieved according to the present invention, namely by a method for stabilizing foodstuffs in which the foodstuffs are in a moist state inside a container suitable as a shipping and retail package and having a vent opening. The foodstuffs are heated with microwaves for a limited period of time but at least until hot steam has formed in the container and escapes through the vent opening. A gas is injected into the container for at least partial compensation of the pressure drop in the container after the end of the heating. The core of the invention thus consists of the fact that a gas is injected into the container for at least partial compensation of the pressure drop in the container after the end of heating.

[0016] Injection of the gas may be performed easily and rapidly in only a few seconds and under a pressure of a few bar, e.g., using a cannula. To this end, the cannula may be inserted through the vent opening. However, the cannula is preferably used to puncture a wall of the container, and the container is flushed with the gas while expelling vapor through the vent opening. It is thermally advantageous if the injection gas is precooled.

[0017] A gas having little or no oxygen content is also preferred as the injection gas with which, in addition to the steam, the oxygen which is still present in the container but is especially harmful for the stability of the foodstuffs is flushed out of the container. Especially good stabilities can be achieved when an inert gas such as nitrogen or an antibacterial gas such as CO₂ or a mixture of these two gases is used as the injection gas.

[0018] The seal on the puncture hole optionally created in the container wall during injection of the gas can be accomplished easily, e.g., by applying an adhesive patch to the container wall.

[0019] By applying an adhesive patch, the vent opening could be sealed if a valve that opens automatically with an excess pressure and closes again automatically when the excess pressure drops is not used for this vent opening. However, even in this case, it may be advantageous, e.g., for an absolutely secure closure to also cover the valve with an adhesive patch as well. If automatic opening of the container to release pressure in regeneration is necessary, then an adhesive patch that is released under the influence of heat may be used.

[0020] In comparison with an adhesive patch that is released under the influence of heat, however, a valve still has the advantage that it allows outgassing of the foods, for example, during storage, shipping and/or the retail phase. After a conventional pasteurization, the enzymatic activity of the food is usually only weakly pronounced as a cause of the evolution of gas.

[0021] If both openings are to be covered with an adhesive patch, then one and the same adhesive patch is advantageously used. In this case, the two openings should not be situated too far apart.

[0022] For use within the scope of the present invention, the valves described in EP 1 076 012 A1 or EP 1 359 097 A1 are suitable in particular, although they should not be destroyed by the thermal stresses that occur during heating in particular. These valves have a suitable flow resistance, which is also stable due to a dimensionally stable valve body and does not change under the resulting loads.

[0023] A defined and approximately constant flow resistance is important so that the result of the stabilizing process can be predictable and repeatable in a narrow tolerance range. Even if only a simple vent opening without a valve function is used, it should have a defined cross section, preferably changing as little as possible.

[0024] Within the scope of the inventive method, it is possible and even preferable to use raw fresh foods. In this case, a temperature of at least 100°C in the vapor and/or 80°C in the core zone of the foodstuffs should be created for their preparation and adequate stabilization. With the microwaves used according to the present invention, this can be achieved within 1-7 minutes, depending on the weight of the product.

[0025] In order for the container to be reliably usable for this purpose, it should be capable of withstanding temperatures up to 150°C during heating and/or an excess pressure of up to 1.5 bar.

[0026] In order for sufficiently high temperatures and/or pressures to be reachable during heating at all, the flow cross section of the vent opening must not be too large. The resulting vapor must stagnate in the container to a certain degree. This is achieved, for example, if the vent opening has a flow cross section of 1-20 mm², preferably 3-7 mm².

[0027] The containers known from EP 1 076 012 A1 comply with the aforementioned requirements and can therefore also be used within the scope of the present invention. Their cover film has a thickness between 40 and 200 µm. It would also be conceivable to use bag-like containers made entirely of such a plastic film or containers having a solid plastic shell and rigid cover. The latter can be manufactured from hard films or by injection molding and have a wall thickness in the range between 600 and 3000 µm. The package sizes may vary between 10 g for small individual portions and 5000 g for large-scale distributor drums.

[0028] The foodstuffs could be pre-prepared and/or blanched entirely or partially before being added to the containers.

[0029] By injection of a gas having a low oxygen content, as explained above, it is possible for the oxygen which is harmful for the stability of the foodstuffs to be removed, at least partially from the container. In addition, this reduction in the oxygen content can be supported by packaging the foodstuffs already under a reduced pressure in the container and/or in a protective gas atmosphere having a low oxygen content.

[0030] As is customary, the containers with the foods that have been stabilized according to this invention are sent to a refrigeration chain with refrigeration temperatures between 1°C and 8°C for the subsequent storage, shipping and retail phases.

[0031] According to another preferred embodiment of the invention, heating is performed as the container passes through a microwave tunnel or a microwave chamber.

[0032] The microwave tunnel is preferably followed directly by an injection station in which the gas is also injected in its run through the station. Preferably the adhesive
patch(es) is/are applied immediately after the gas injection in the injection station although essentially a separate station could be provided for this.

[0033] For conveyance of the container through the microwave tunnel and through the injection station, a conveyance mechanism is advantageously used. In particular, this may be the same conveyor system. To improve the economic aspect of the method, the containers may be conveyed in several rows side-by-side through the microwave tunnel and/or the injection station.

BRIEF DESCRIPTION OF THE FIGURES

[0034] The present invention is explained in greater detail below on the basis of exemplary embodiments in conjunction with the drawings, in which:

[0035] FIG. 1a shows a container having a valve as a vent opening and containing foods prior to the latter being stabilized, this container being suitable for use within the context of the inventive method.

[0036] FIG. 1b shows the valve from FIG. 1a in an enlarged diagram.

[0037] FIG. 2a shows the container from FIG. 1 during heating by two microwaves.

[0038] FIG. 2b shows the valve from FIG. 2a in an enlarged diagram.

[0039] FIG. 3 shows the same container as in FIG. 1 or 2 after recoupling and condensation of the vapor formed during heating according to the state of the art.

[0040] FIG. 4 shows the injection of a gas via a cannula into the container after heating according to FIG. 2.

[0041] FIG. 4a shows a preferred embodiment of the cannula tip in an enlarged diagram.

[0042] FIG. 5 shows the sealing of the puncture hole caused by the cannula according to FIG. 4 by an adhesive patch.

[0043] FIG. 6 shows the container from the preceding figures with the foods stabilized according to this invention.

[0044] FIG. 7 shows another container suitable for use within the scope of the inventive method and having a simple vent opening and foods in the phase according to FIG. 4 whereby the gas is injected through the vent opening by a cannula.

[0045] FIG. 8 shows the container from FIG. 7 after retraction of the cannula and closure of the vent opening with an adhesive patch.

[0046] FIG. 9 shows a container with foods according to FIG. 8 but with the cannula inserted next to the vent opening and with the adhesive patch for sealing the puncture hole, shown on an enlarged scale accordingly.

[0047] FIG. 10 shows a device for automated implementation of the inventive method.

DETAILED DESCRIPTION OF THE INVENTION

[0048] FIG. 1 shows a shell-shaped container 10 made of plastic with a peripheral edge 11 onto which is welded a cover film 12 also around the edge. The cover film may be a plastic film, optionally in several layers, with a thickness in the range between 40 and 220 µm. A vent opening 20 is provided in the cover film 12 through which a valve 21 that opens automatically under excess pressure and closes again automatically after the pressure has dropped is formed, as is known essentially from EP 1 359 097 A1. Foodstuffs 30, which still have a certain inherent moisture content and are still in a raw fresh state, are contained in the container 10.

[0049] FIG. 1b shows the valve 21 on an enlarged scale. It is made of plastic and has a dimensionally stable valve body 22 in which there are multiple openings 23. The openings 23 are sealed by an elastic membrane 24 which is held in position by a web 25. The sealing effect of the membrane is supported by sealing oil which is present especially in a groove 26.

[0050] FIG. 2a shows the container 10 during heating with microwaves M to stabilize the foodstuffs 30, with steam D being formed from the moisture present in the foodstuffs 30 and causing an excess pressure P> in the container 10. Under the influence of this excess pressure P>, the valve 21 has opened so that steam D can flow out of the container 10. Furthermore, the cover film 12 has bulged up under the influence of the excess pressure P>.

[0051] FIG. 2b shows the valve 21 from FIG. 2a in the openended state with the membrane 24 having an elastic bulge.

[0052] If the container 10 of FIG. 2a were to be left to itself after being heated, then the valve 21 would close again at some point with the onset of recoupling, a decline in vapor formation and another drop in pressure and then a considerable vacuum P< would develop in the container 10 especially due to the resulting condensation of the vapor that is still present, as is known from the state of the art cited in the introduction, for example. FIG. 3 shows a container 10 having a cover film 12 bulging inward under such a vacuum P<.

[0053] The present invention counteracts the development of such a reduced pressure by injection of a gas G into the container 10. This is accomplished in FIG. 4 by a cannula 40 with which the cover film 12 (as the thinnest container wall) is punctured once. The container 10 is preferably even flushed with the gas G, expelling steam D through the valve 21. The gas G is injected, e.g., with an excess pressure of 1-5 bar, preferably 3 bar. In this case it is sufficient to flush the container for 1-20 seconds, preferably for approximately 8 seconds.

[0054] Preferably, a mixture of nitrogen and CO₂ in a volume ratio of 80:20-70:30 is used as the gas G, where the gas G is preferably precooled to a temperature of less than 12°C.

[0055] To prevent a reduced pressure P< from being able to develop even temporarily in the container 10, the injection of the gas G must be performed relatively rapidly but preferably within 150 seconds after the end of heating.

[0056] FIG. 4a shows a preferred embodiment of the tip of a cannula 40 in an enlarged diagram which shows the actual tip as a rectangle provided with sharp polished edges to simplify insertion. Four outflow openings 41 for the gas G are distributed radially over the circumference above the polished area. An especially uniform and effective flushing of the container with gas is achieved with this embodiment.

[0057] FIG. 5 shows the container 10 after injection of the gas G, the cannula 40 having already been retracted back out of the container 10. Then approximately ambient pressure prevails in the container, this being discernible by the flat shape of the cover film 12. Excess pressure generated by the injection of the gas into the container 10 could be dissipated through the valve 21 and/or through the puncture hole 13 created by the cannula 40 in the cover film 12. The valve 21 was also able to close again and the pressure was successfully equalized.

[0058] In order for the valve 21 to be able to close tightly again, the abovementioned sealing oil must at least not be flushed out completely by the hot steam flowing through the valve 21 during heating in the valve design illustrated in FIG. 1b. It is advantageous here if the sealing oil is a silicone oil.
and/or has a viscosity (at 20°C) of 1000-20,000 Centipoise and/or is present in an amount of 4-8 mg.

0059] To completely reseal the container 10, the puncture hole 13 in the cover film 12 is also sealed by applying an adhesive patch 50, as also depicted in FIG. 5.

0060] For applying the adhesive patch 50, a stamp 60 which receives the adhesive patch 50 in its position shown in FIG. 4, e.g., from a label dispenser (not shown), is used in FIG. 5 and holds the adhesive patch, e.g., by suction, until it is applied to the container 10.

0061] The stamp 60 executes a pivoting movement, which is advantageous in that the container 10 need not be moved to apply the adhesive patch 50 after retraction (linear here) of the cannula 40. Application of the adhesive patch 50 immediately after retraction of the cannula 40 is therefore possible and is also ensured if the container is conveyed on a conveyor belt of a conveyor device, for example, and if the conveyor belt comes to a standstill. Alternatively or additionally, the cannulas 40 could of course also be guided in a nonlinear manner.

0062] The adhesive patch 50 should preferably also be applied immediately after retracting the cannula so that no microorganisms can enter the container from the outside. A period of time of 60 seconds between the injection of the gas and the application of the adhesive patch is tolerable, however.

0063] FIG. 6 shows the container 10 with the foodstuffs 30 that have been stabilized according to this invention in the gas atmosphere G under ambient pressure and the adhesive patch 50 which is attached here. In this form, the container is suitable as a shipping and retail packaging and is preferably sent to a conventional refrigeration chain with refrigeration temperatures in the range between 1 and 8°C., for example.

0064] FIGS. 7-9 show an alternative embodiment with a container 10 which, instead of being provided with a valve, has a vent opening 20 of a simple design in which the cover film 12 is provided. However, the vent opening 20, like the valve 21, has a dimensionally stable body 27 with a defined opening 28 and therefore with a defined flow resistance which at least has not changed significantly under the stresses that occur during heating. After injection of the gas G, the opening 28 must be actively closed, which may again be accomplished with an adhesive patch.

0065] In the example in FIG. 7, the gas G is injected directly through the opening 28 into the container 10 with a cannula 40, so that no additional injection hole is formed. In this case, it is sufficient to apply a single adhesive patch 51 over the opening 28 to seal the container 10. However, one disadvantage with this variant is that the container 10 cannot be flushed so effectively with the gas.

0066] However, it is also possible to inject the gas into the container 10 at a point that is not too great a distance away from the vent opening 20 and/or 28. In this case, flushing can be more effective and the container 10 can still be sealed by applying just one adhesive patch 52, optionally somewhat larger, as illustrated in FIG. 9.

0067] FIG. 10 shows a device for automated performance of the inventive method with a conveyor device 70 having a conveyor belt 71 which is passed through a microwave tunnel 80 and an injection station 90. A plurality of containers 10, as shown here, can be conveyed on the conveyor belt 71 through the microwave tunnel and through the injection station. The heating of the containers 10 and the foodstuffs contained in the containers takes place in microwave tunnel 80 by means of microwaves, and in the injection station the gas injection described above is performed and the adhesive patch(s) is/are applied. The device from FIG. 10 may also be designed so that several containers are transported side-by-side in several rows through the microwave tunnel 80 and the injection station 90.

0068] What has been described above are preferred aspects of the present invention. It is of course not possible to describe every conceivable combination of components or methodologies for purposes of describing the present invention, but one of ordinary skill in the art will recognize that many further combinations and permutations of the present invention are possible. Accordingly, the present invention is intended to embrace all such alterations, combinations, modifications, and variations that fall within the spirit and scope of the appended claims.

LIST REFERENCE NUMERALS

10 container
11 edge of container
12 cover film
13 puncture hole
20 vent opening
21 valve
22 valve body
23 openings in the valve body
24 membrane
25 web
26 groove for sealing oil
27 dimensionally stable body
28 opening in 27
30 foodstuff
40 cannula
41 outflow openings
50 adhesive patch
51 adhesive patch
52 adhesive patch
60 stamp
70 conveyor device
71 conveyor belt
80 microwave tunnel
90 injection station
D steam
G gas
P> excess pressure
P< reduced pressure

1. A method for stabilizing foodstuffs in which the foodstuffs are in a moist state inside a container, having a wall, suitable as a shipping and retail package, the packing having a vent opening, said method comprising the steps of:
   heating the foodstuffs with microwaves for a limited period of time, but at least until hot steam has formed in the container and escapes through the vent opening; and
   injecting a gas into the container for at least partial compensation of the pressure drop in the container after the end of the step of heating the foodstuffs.

2. The method according to claim 1, wherein the gas is at least one of an oxygen-free gas, nitrogen and CO₂.

3. The method according to claim 1, wherein said step of injecting the gas comprises injecting the gas at an excess pressure of 1-5 bar.

4. The method according to claim 1, comprising the step of precooling the gas to be injected to a temperature of less than 12°C.
5. The method according to claim 1, wherein said step of injecting the gas comprises injecting the gas within 150 seconds after the end of said heating step.

6. The method according to claim 1, wherein said step of injecting the gas comprises injecting the gas for 1-20 seconds.

7. The method according to claim 1, wherein said step of injecting the gas into the container comprises flushing the container with the gas, to expel steam through the vent opening.

8. The method according to claim 1, wherein said step of injecting the gas comprises using a cannula to inject the gas.

9. The method according to claim 8, wherein said step of injecting the gas comprises puncturing the wall of the container with the cannula to form a puncture hole.

10. The method according to claim 9, wherein the wall of the container that is punctured with the cannula comprises a plastic film having a thickness in the range between 40 and 220 μm.

11. The method according to claim 9, further comprising the steps of:
    retracting the cannula; and
    sealing the puncture hole in the container wall after retracting the cannula.

12. The method according to claim 11, wherein said step of seal the puncture hole comprises applying an adhesive patch to the container wall.

13. The method according to claim 1, further comprising the step of sealing the vent opening after injecting the gas.

14. The method according to claim 13, wherein said vent opening comprises a valve that opens automatically under excess pressure and closes again automatically after the excess pressure drops.

15. The method according to claim 14, further comprising the step of sealing said valve with an oil as a sealing agent, wherein the oil is at least one of a silicone oil, has a viscosity of 1000-20,000 Centipoise at 20° C. and is present in an amount of 4-8 mg.

16. The method according to claim 13, wherein said step of sealing the vent opening comprises applying an adhesive patch.

17. The method according to claim 16, wherein the same adhesive patch is used for sealing the puncture hole and the vent opening.

18. The method according to claim 12, wherein the adhesive patch is applied within 60 seconds after injection of the gas.

19. The method according to claim 1, wherein at least one of a temperature of at least 100° C. is created in the steam and 80° C. in the core zone of the foodstuff within 7 minutes during heating in the container.

20. The method according to claim 1, wherein said step of heating the foodstuffs comprises passing the container through a device selected from the group consisting of a microwave tunnel and a microwave chamber.

21. The method according to claim 1, further comprising the steps of:
    passing the container through an injection station; and
    injecting the gas during said step of passing the container through the injection station.

22. The method according to claim 21, wherein said step of applying the adhesive patch occurs during the step of passing the container through the injection station.

23. The method according to claim 21, comprising the step of conveying the container on a conveyor system through the microwave tunnel and the injection station.

24. The method according to claim 23, wherein said conveyor system comprises a conveyor device for conveying multiple containers simultaneously in several rows side-by-side.

25. The method according to claim 1, wherein the foodstuffs are packaged in the container in a raw fresh state.

26. The method according to claim 1, wherein the foodstuffs are packaged in the container under reduced pressure and/or in a protective gas atmosphere having a low oxygen content.

27. The method according to claim 1, further comprising the step of supplying the container to a refrigeration chain having refrigeration temperatures between 1 and 8° C. after injection of the gas.

28. The method according to claim 1, wherein said container withstands temperatures up to 150° C. during heating.

29. The method according to claim 1, wherein said container withstands an excess of up to 1.5 bar absolute during heating.

30. The method according to claim 1, wherein said vent opening of said container has a defined flow resistance which does not change even under the stresses occurring during heating and has a flow cross section of 1-20 mm².

31. The method according to claim 2, wherein the gas is a mixture of nitrogen and CO₂ in a volume ratio of 80:20 to 70:30.

32. The method according to claim 3, wherein said step of injecting the gas comprises injecting the gas at an excess pressure of 3 bar.

33. The method according to claim 6, wherein said step of injecting the gas comprises injecting the gas 8 seconds.

34. The method according to claim 10, wherein said plastic film comprises multiple layers.

35. The method according to claim 30, wherein said vent opening has a flow cross section of 3-7 mm².

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