

Description

SYRINGE SUITABLE FOR HYDROGEN PEROXIDE SOLUTION, AND KIT

TECHNICAL FIELD

[0001]

The present invention relates to a syringe, and particularly to a syringe made of a material having a lower rate of metal ion elution in the presence of a hydrogen peroxide solution compared with glass.

BACKGROUND

[0002]

A hydrogen peroxide solution is used industrially as a bleaching agent, and as a disinfectant in the food industry. A hydrogen peroxide solution containing 2.5 to 3.5% (w/v) hydrogen peroxide (known as “oxydol” in the Japanese Pharmacopoeia) is used for medical purposes as a disinfectant.

[0003]

This hydrogen peroxide solution can be used as a radiosensitizer by mixing it with a solution of hyaluronic acid or a salt thereof such as sodium hyaluronate in a pre-determined ratio, and then injecting the mixture into a tumor just before the therapeutic radiation dose (Patent Document 1).

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0004]

Patent Document 1: WO2008/041514

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

Because hydrogen peroxide decomposes rapidly when removed from a special storage container that shields it from light, it must be drawn out in the appropriate volume or weight and then mixed with the sodium hyaluronate solution just before injection, when used as a radiation sensitizer as in Patent Document 1. This places an extra burden on the medical personnel treating the patient. Either the hospital pharmacy must draw out the hydrogen peroxide solution and mix it with the sodium hyaluronate, or a physician must do so at the patient's bedside. In the former case, the pharmacy personnel are burdened and there is risk of delay in transporting the injection mixture from the pharmacy to the patient's bedside. In the latter case, medical personnel at the patient's bedside, who are preparing the patient for radiotherapy, are burdened. In both cases, the complications of drawing out and mixing the solutions increase risks of mistakes that might compromise medical treatment or

endanger the patient.

[0006]

In addition, if the hydrogen peroxide solution is prefilled using a syringe made of conventional glass (for example, borosilicate glass), the glass syringe expands during storage of the hydrogen peroxide solution and the gasket thereof is pushed back. This might interfere with the long-term storage of the hydrogen peroxide solution in such a glass syringe.

MEANS FOR SOLVING THE PROBLEMS

[0007]

An object of the present invention is to provide a syringe including a portion thereof contacting a hydrogen peroxide solution,

in which the portion is made of cycloolefin polymer (COP) or cycloolefin copolymer (COC).

[0008]

By using the syringe, it is possible to limit the decomposition of hydrogen peroxide in the hydrogen peroxide solution. Thus, using the pre-filled syringe, a hydrogen peroxide solution can be stored for a long time.

[0009]

The syringe may be suitable for prefilling with a hydrogen peroxide solution.

[0010]

The syringe may further include the hydrogen peroxide solution in the syringe. The hydrogen peroxide solution may include hydrogen peroxide and water.

[0011]

The hydrogen peroxide solution may include an additive.

[0012]

The syringe may further include a nozzle in a needle mounting part of the syringe.

[0013]

When the syringe is already equipped with a nozzle, rapid administration is possible.

[0014]

The nozzle may include a nozzle part and an adapter part connected to the needle mounting part of the syringe.

The nozzle part may be a needle or a spray nozzle.

[0015]

The needle may have a groove in an echogenic pattern on an outer surface thereof.

[0016]

The syringe may further include a protector. The nozzle part may be covered with the protector.

[0017]

The protector may include a support member, a nozzle protection part connected to one end of the support member, and an engagement part connected to the other end of the support member.

The nozzle protection part may include a space capable of accommodating the nozzle part.

[0018]

The engagement part may include a movable part and may be movably connected to the other end of the support member via the movable part.

[0019]

The space may be located along the inner surface of the lateral wall of the nozzle protection part.

[0020]

The support member may include a first arm, a second arm, a first movable part, a second movable part, and a third movable part.

One end of the first arm may be movably connected to the nozzle protection part via the first movable part. The other end of the first arm may be movably connected to one end of the second arm via the second movable part. One end of the second arm may be movably connected to the engagement part via the third movable portion.

[0021]

The movable part may include a rail part connected to the nozzle protection part and a rail holding part connected to the engagement part.

The rail holding part may hold the rail part slidably.

[0022]

The space may be positioned inside the nozzle protection part.

The nozzle protection part may have a hollow structure.

[0023]

The syringe may further include a syringe pump.

[0024]

Concentration of the hydrogen peroxide in the hydrogen peroxide solution may be 0.01 to 40% (w/v).

[0025]

Another object of the present invention is to provide a kit including the syringe and the nozzle.

[0026]

By using the kit, it is not necessary to choose the nozzle for the syringe. As a result, rapid administration can be facilitated.

[0027]

The kit may further include a protector for covering the nozzle part.

EFFECT OF THE INVENTION

[0028]

According to the present invention, it is possible to provide the prefilled syringe capable of storing the hydrogen peroxide solution for a long period of time until it can be used as a radiosensitizer. As a result, rapid administration can be performed. Moreover, safe administration can be performed by providing the nozzle with the protector. By using a needle as the nozzle, the hydrogen peroxide solution can be administered easily and safely. Alternatively, by using a spray nozzle as the nozzle, the hydrogen peroxide solution can be administered by spraying easily and safely. By using the syringe pump, the prefilled syringe can be operated stably, delivering the prefilled solution at a pre-determined appropriate rate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

FIG. 1 shows a schematic view of a prefilled syringe containing a hydrogen peroxide solution according to the present embodiment.

FIG. 2 shows a prefilled syringe with a needle according to the present embodiment.

FIG. 3 shows a prefilled syringe with a spray nozzle according to the present embodiment.

FIG. 4 is a partially enlarged cross-sectional view of the spray nozzle according to the present embodiment.

FIG. 5 shows a prefilled syringe with a protector according to the present embodiment.

FIG. 6 shows a prefilled syringe with a movable protector in protection mode according to the present embodiment.

FIG. 7 shows a prefilled syringe with a movable protector in administration mode according to the present embodiment.

FIG. 8 shows a prefilled syringe with a lifting protector in protection mode according to the present embodiment.

FIG. 9 shows a prefilled syringe with a slide-type protector in administration mode according to the present embodiment.

FIG. 10 shows a prefilled syringe equipped with a syringe pump according to the present embodiment.

FIG. 11 is a schematic diagram illustrating the operation of a syringe pump according to the present embodiment.

FIG. 12 shows a graph of residual rates of hydrogen peroxide of each syringe material in the example.

DESCRIPTION OF THE EMBODIMENTS

[0030]

Definition

For convenience, certain terms employed in the context of the present disclosure are collected here. Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of the ordinary skilled in the art to which this invention belongs. The singular forms "a", "and", and "the" are used herein to include plural referents unless the context clearly dictates otherwise.

[0031]

Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the invention are approximations, the numerical values set forth in the specific examples are described as precisely as possible. Any numerical value, however, inherently contains certain errors necessarily resulting from the standard deviation found in the respective testing measurements. Also, as used herein, the term "about" generally means within 10%, 5%, 1%, or 0.5% of a given value or range. Alternatively, the term "about" means within an acceptable standard error of the mean when considered by one of ordinary skill in the art.

[0032]

"Protection mode" in the present specification herein means a state in which skin cannot access a tip of a nozzle part by a protector, that is, a state where administration cannot be performed. "Administration mode" used in the present specification means a state in which the tip of the nozzle part is exposed from the protector, that is, a state where administration can be performed.

[0033]

Hereinafter, embodiments of the present invention are illustrated in detail. The following embodiments are illustrative only and do not limit the scope of the present invention. In order to avoid redundancy, explanation for similar contents is not repeated.

[0034]

Syringe

A syringe according to the present embodiment includes a portion thereof contacting a hydrogen peroxide solution,

in which the portion is made of cycloolefin polymer (COP) or cycloolefin copolymer (COC).

[0035]

The syringe may be suitable for prefilling with a hydrogen peroxide solution. The syringe may further include the hydrogen peroxide solution in the syringe. The hydrogen peroxide solution may includes hydrogen peroxide and water. The hydrogen peroxide solution may include an additive.

[0036]

FIG. 1 shows a schematic diagram of a prefilled syringe (1) filled with hydrogen peroxide solution (50) according to the present embodiment. In the present embodiment, a syringe (10), particularly a barrel (20) of the syringe (10), has generally cylindrical shape. In the present embodiment, the syringe (10) has, at one end thereof, a needle mounting part (30) from which the hydrogen peroxide solution (50) is discharged. In the present embodiment, the syringe (10) has, at the other end thereof, a rod-inserted part (80) for inserting a plunger rod (70). In the present embodiment, the syringe (10) has a flange (90) provided around the rod-inserted part (80). In order to seal the filled hydrogen peroxide solution (50), the prefilled syringe (1) shown in FIG. 1 has a cap (40) provided on the needle mounting part (30) and the plunger rod (70) inserted from the rod-inserted part (80), the plunger rod (70) having a gasket (60).

[0037]

In the present embodiment, the syringe for hydrogen peroxide solution means a syringe having a low decomposition capability of hydrogen peroxide in the hydrogen peroxide solution. In the present embodiment, the hydrogen peroxide solution means a solution in which a solvent (for example, water) contains hydrogen peroxide and if necessary, additives (for example, phosphoric acid and phenacetin, other than gel substrate). In an embodiment, the hydrogen peroxide solution is substantially free of the gel substrate (e.g., hyaluronic acid, salt of hyaluronic acid, hydrogel and gelatin). "Substantially free" means, for example, that the concentration of the gel substrate in the solution is less than 0.1% by mass, less than 0.05% by mass, less than 0.01% by mass, less than 0.005% by mass or less than 0.001% by mass or less than 0.1%(w/v), less than 0.05%(w/v), less than 0.01%(w/v), less than 0.005%(w/v) or less than 0.001%(w/v).

In another embodiment, the hydrogen peroxide solution does not include the gel substrate. In the present embodiment, the syringe may be manufactured from a single material or may be made with a plurality of materials (including a multilayer structure such as a coating). In the case of the syringe manufactured from the single material, the entire syringe is made of plastic such as COP and COC.

In the case of the syringe made with a plurality of materials, the part where the syringe contacts with the hydrogen peroxide solution directly is made of the plastic, the remaining part may be made of a material having high decomposition capability of the hydrogen peroxide such as glass. In addition, all parts that come into contact with the hydrogen peroxide solution need to be made of the plastic. Thus, the main part such as the inner surface of the barrel of the syringe may be made of the plastic. In other words, parts that may come into contact with the hydrogen peroxide solution, such as a plunger rod, luer lock, cap and gasket, need to be made of the plastic. In addition, a lubricant such as silicone oil may be applied to the inner surface of the barrel of the syringe body.

[0038]

The decomposition capability of hydrogen peroxide can be determined from the ratio of the concentration of hydrogen peroxide in the hydrogen peroxide solution after start of storage to the

concentration of hydrogen peroxide in the hydrogen peroxide solution before the start of the storage under specific temperature condition (residual rate of hydrogen peroxide). The storage is performed in a sealed state. Temperature condition is not limited, but may be 35 °C, 37 °C, 40° C, or 60 °C. A period of the storage is not limited, but may be one week, two weeks, three weeks, or four weeks, or four weeks or more. The concentration of hydrogen peroxide in the hydrogen peroxide solution before the start of the storage may be any concentration, for example in the range of 0.01 to 40% (w/v). In an embodiment, the decomposition capability of hydrogen peroxide to the plastic is lower than that of a glass. The residual rate of hydrogen peroxide in the plastic may be 70% or more, preferably 75% or more, more preferably 78% or more, still more preferably 80% or more under the condition that a solution containing 2.5 to 3.5% (w/v) hydrogen peroxide is hermetically stored at 60 °C for 4 weeks. The amount of hydrogen peroxide in the hydrogen peroxide solution can be determined by titration with a potassium permanganate solution according to an oxydol determination method described in Japanese Pharmacopoeia.

[0039]

In the present embodiment, the plastic may include COP, COC and a polypropylene, but not limited to them as long as the plastic has a lower decomposition capability of hydrogen peroxide than glass.

[0040]

Nozzle

FIG. 2 shows the prefilled syringe (1) with a nozzle (100). The nozzle (100) is attached to the needle mounting part (30) of the prefilled syringe (1). The nozzle (100) may be pre-mounted on the needle mounting part (30) of the prefilled syringe (1) or may be included in a kit including the prefilled syringe (1). When the nozzle (100) is pre-mounted on the needle mounting part (30) of the prefilled syringe (1), the nozzle (100) (or prefilled syringe (1)) preferably includes a blocking mechanism that prevents leakage of the hydrogen peroxide solution (50) until the prefilled syringe (1) is used.

[0041]

The nozzle (100) includes a nozzle part (110) and adapter part (120) connected to the nozzle part (110). The adapter part (120) is connected to the needle mounting part (30) of the prefilled syringe (1). The inside of nozzle part (110) is in fluid communication with the inside of the adapter part (120).

[0042]

The prefilled syringe 1 shown in FIG. 2 includes a needle 111 as the nozzle part 110. In another embodiment, the prefilled syringe 1 includes a spray nozzle 112 as the nozzle part 110 (FIG. 3). The spray nozzle 112 shown in FIG. 3 is integrally molded in the adapter part 120. In another embodiment, the spray nozzle 112 is detachably attached to the adapter part 120.

[0043]

FIG. 4 shows a partial enlarged cross-sectional view of the spray nozzle (112) shown in FIG. 3. The cross-sectional view of FIG. 4 represents a cross section of the prefilled syringe (1) shown in FIG. 3 passing through the central axis A-A. The spray nozzle (112) includes an outlet (112A), orifice (112B), and inlet (112C). The inner diameter of the outlet (112A) according to the present embodiment decreases from the outside of the spray nozzle (112) toward the orifice (112B). The inner diameter of the inlet (112C) according to the present embodiment decreases from the inside of the spray nozzle (112) toward the orifice (112B). Depending on the desired particle size of hydrogen peroxide solution (50), the inner diameter of orifice (112B) can be varied. The inner diameter of the outlet (112A) may be the same as the inner diameter of the orifice (112B), and the inner diameter of the inlet (112C) may be the same as the inner diameter of the orifice (112B). The inner diameter of the spray nozzle (112) may be constant.

[0044]

The needle (111) may have a groove with an echogenic pattern groove on an outer surface thereof. The echogenic pattern is not particularly limited as long as it is the groove pattern that improves the visibility of the needle (111) even under an ultrasonic image.

[0045]

Protector

FIG. 5 shows the prefilled syringe (1) equipped with a protector (200). The protector (200) can cover the nozzle (100). The protector (200) may be detachably connected to the adapter part (120) (or prefilled syringe (1)) of the nozzle (100) by fitting or screwing. The protector (200) may include a blocking mechanism that prevents leakage of the hydrogen peroxide solution (50) of the prefilled syringe (1). The blocking mechanism can prevent leakage of the hydrogen peroxide solution (50) of the prefilled syringe (1), for example, by contacting the inside of the tip of the protector (200) with the tip of the nozzle (100).

[0046]

Movable protector

FIGs. 6 and 7 show the prefilled syringe 1 equipped with a moveable protector (300). The movable protector (300) shown in FIG. 6 protects the nozzle part 110. The movable protector (300) shown in FIG. 7 is positioned so as to expose the nozzle part (110).

[0047]

The movable protector (300) includes a support member (320), a nozzle protection part (310) connected to one end (321) of the support member (320), and an engagement part (330) connected to the other end (322) of the support member (320). The engagement part (330) is connected to the other end (322) of the support member (320) via the movable part (340). The engagement part (330) is detachably connected to the adapter part (120).

[0048]

The nozzle protection part (310) of the movable protector (300) has a space that can accommodate the nozzle part (110) of the nozzle (100) in the nozzle protection part (310). In the present embodiment, the space is groove (311). The groove (311) is formed on a side wall (314) of the nozzle protection part (310). A front end (312) of the nozzle protection part (310) is closed. A rear end (313) of the nozzle protection part (310) is open.

[0049]

The moveable protector (300) can expose the nozzle part (110) of the nozzle (100) from the groove (311) of the nozzle protection part (310) by rotating the movable protector (300) around the movable part (340) as a rotation axis without physically separating the movable protector (300) from the adapter part (120), and vice versa.

[0050]

The movable protector (300) may include a plurality of the support members (320). When the movable protector (300) includes a plurality of the support members (320), each of the support members (320) may be connected via a movable part. The engagement part (330) may be engaged with the adapter part (120) of the nozzle (100) or the prefilled syringe (1). In the present embodiment, the movable part (340) is a pivot part including a shaft but is not limited thereto. The movable part (340) may be a bent part that can be bent. When the movable part (340) is the bent part, the support member (320) and the engagement part (330) may be integrally formed.

[0051]

Slide-type protector

FIGs. 8 and 9 show the prefilled syringe 1 equipped with a slide-type protector (400). The slide-type protector (400) shown in FIG. 8 protects the nozzle part (110). The slide-type protector (400) shown in FIG. 9 is positioned so as to expose the nozzle part (110).

[0052]

The slide-type protector (400) includes a support member (420), a nozzle protection part (410) connected to one end of the support member (420), and an engagement part (430) connected to the other end of the support member (420). The engagement part (430) is detachably connected to the adapter part (120). The support member (420) includes a first arm (421), a second arm (422), a first movable part (441), a second movable part (442), and a third movable part (443). In the present embodiment, the nozzle protection part (410) has a hollow structure, and has a space that can accommodate a front end of the nozzle part (110) from a rear end (413) of the nozzle protection part (410). When the slide-type protector (400) is in a protection mode, the front end of the nozzle part (110) is accommodated in the nozzle protection part (410). When the slide-type protector (400) is in an administration mode, the front end of the nozzle part (110) protrudes from an opening (411) of the nozzle protection part (410). In the present embodiment, the opening (411) has a cross shape, but

may have another shape.

[0053]

One end (421A) of the first arm (421) is movably connected to the nozzle protection part (410) via the first movable part (441). The other end (421B) of the first arm (421) is movably connected to one end (422A) of the second arm (422) via the second movable part (442). The other end (422B) of the second arm (422) is movably connected to the engagement part (430) via the third movable part (443).

[0054]

By rotating each arm with respect to the central axis of each movable part so that the second movable part (442) is away from the nozzle (100), the nozzle protection part (410) can be moved in the direction of the adapter part (120), resulting that the nozzle part (110) of the nozzle (100) can be exposed from the opening (411) of the nozzle protection part (410) without physically separating the slide-type protector (400) from the adapter part (120), and vice versa.

[0055]

The number of the arms and the number of the movable parts can be changed as necessary. The length of the arm can be changed according to the length of the nozzle part (110).

[0056]

Another embodiment

In another embodiment, the slide-type protector (400) includes a rail part, a nozzle protection part (410) connected to one end of the rail part, and a rail holding part connected to the other end of the rail part. The rail holding part hold the rail part slidably. The rail holding part is detachably connected to the adapter part (120). The opening (411) is provided at the front end of the nozzle protection part (410). By sliding the nozzle protection part (410) in the longitudinal direction of the prefilled syringe (1), the nozzle part (110) can be accommodated in or exposed from the opening (411).

[0057]

Syringe pump

FIG. 10 shows the prefilled syringe (1) equipped with a syringe pump (500). The syringe pump (500) in the present embodiment includes slits (510) into which one end of the flange (90) of the prefilled syringe (1) is inserted, a holder (520) that fixes the prefilled syringe (1), a movable wall (530) that pushes the plunger rod (70) of the prefilled syringe (1), a monitor (540), switches (550), a processor (560), a memory (561), a pressure sensor (562), a battery (563), and an electric motor (564).

[0058]

The monitor (540) and switches (550) are provided on the first surface (501A) of the syringe pump (500). The movable wall (530) is provided on the second surface (501B) of the syringe pump (500). The second surface (501B) of the syringe pump (500) is provided at a lower position than the first surface (501A) of the syringe pump (500). The first surface (501A) of the syringe pump (500)

is connected to the second surface (501B) of the syringe pump (500) via the first wall (502A) of the syringe pump (500). The slits (510) are formed so as to pass through the first surface (501A) and first wall (502A) of the syringe pump (500).

[0059]

The movable wall (530) is connected to two threaded rods (570A) and (570B) provided on the second surface (501B). When the threaded rods (570A) and (570B) are rotated by, for example, the electric motor (564), the movable wall (530) can move in the direction of pushing (or pulling) the plunger rod (70) of the prefilled syringe (1). The movable wall (530) of the syringe pump (500) is electrically driven but may be mechanically driven.

[0060]

When the syringe pump (500) is used, one end of the flange (90) of the prefilled syringe (1) is inserted into any one of the slits (510). By inserting one end of the flange (90) of the prefilled syringe (1) into the slit (510), the movement of the prefilled syringe (1) in the moving direction of the movable wall (530) is prevented. Depending on the length of the prefilled syringe (1), any one of the slits (510) can be selected.

[0061]

The prefilled syringe (1) is further fixed by the holder (520). The holder (520) is configured to press the prefilled syringe (1) against the first wall (502A) and second surface (501B). By fixing the prefilled syringe (1) using the holder (520), the prefilled syringe (1) is prevented from falling off the syringe pump (500).

[0062]

Operation of the syringe pump (500) will be described with reference to FIG. 11. The syringe pump (500) is moved by the battery (563) power. The operation of the syringe pump (500) can be set by operating the switches (550). Requests from the switches (550) are processed by the processor (560). The processor (560) can read out necessary information (such as a program) from the memory (561) upon the request and can store the necessary information in the memory (561). The processor (560) can display a processing result on the monitor (540). When the processor (560) receives a request to move the syringe pump (500), the processor (560) processes the request so that electric motor (564) rotates. Based on the information of the pressure sensor (562) connected to the movable wall (530), the processor (560) can process the information so that the electric motor (564) stops.

[0063]

The syringe pump (500) can set a flow rate, administration time, an inner diameter of the syringe, a pressure threshold, and the like, thereby enabling stable administration.

[0064]

kit

In yet another embodiment, a kit including: the syringe and the nozzle is provided.

[0065]

The kit includes the prefilled syringe (1) and nozzle (100). The kit may include a plurality of the prefilled syringes (1) and nozzles (100). The kit may include the protector (200), (300) or (400) that covers the nozzle (100). The kit may include additional elements (e.g., instructions or dosing schedules) for treatment of tumors with anti-cancer drug or radiation.

[0066]

In the present embodiment, the concentration of hydrogen peroxide in the hydrogen peroxide solution in the prefilled syringe is, for example, 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.5, 1, 5, 10, 15, 20, 25, 30, 35 or 40%, or may be in the range between any two of the numerical values exemplified herein, for example, 0.01 to 40% (w/v), preferably, 0.05 to 30% (w/v).

[0067]

Material

The material of the nozzle part (110) can be changed according to the purpose and situation of the use of the present embodiment. When the nozzle part (110) is the needle (111), the material of the nozzle part (110) (that is, the needle (111)) may be a metal such as stainless steel. The material of the adapter part (120) may be a resin (e.g., COP, COC, polypropylene, and polycarbonate), metal, rubber or glass. When the nozzle part (110) is the spray nozzle (112), the material of the nozzle part (110) (i.e., spray nozzle (112)) may be resin (e.g., COP, COC, polypropylene and polycarbonate), metal, rubber or glass. When the spray nozzle (112) is formed integrally with the adapter part (120), the same material as that of the adapter part (120) is used.

[0068]

The material of the protector (200) can include, but not limited to, resins (for example, COP, COC, polypropylene, and polycarbonate), metal, rubber and glass. The material of the movable protector (300) and the slide-type protector (400) may be the same as the material of the protector (200). The material of the movable parts of the movable protector (300) and the slide-type protector (400) (the movable part (340), first movable part (441), second movable part (442) and third movable part (443)) may be different from the material of other parts of the movable protector (300) and slide-type protector (400) depending on the purpose and situation of the use of the present embodiment. .

[0069]

A housing of the syringe pump (500) may be made of metal or resin (for example, polycarbonate). The material of the movable wall (530) may be the same as or different from the material of the housing of the syringe pump (500). The holder (520) may be made of metal, rubber or resin. The threaded rods (570A) and (570B) are preferably made of metal but may be resin.

EXAMPLES

[0070]

Hydrogen peroxide solution stability test

Stability test of a hydrogen peroxide solution was performed using a glass syringe, a COP syringe, and a COC syringe. 1 mL of the hydrogen peroxide solution was added to each syringe, sealed, and then stored at 60 °C for 4 weeks. The residual rates of hydrogen peroxide in the hydrogen peroxide solutions after storage were measured. Oxydol "KENEI" (containing 2.5 to 3.5%(w/v) hydrogen peroxide, phosphoric acid and phenacetin) manufactured by Kenei Pharmaceutical Co., Ltd. was used as the hydrogen peroxide solution. The amount of hydrogen peroxide in the hydrogen peroxide solution was detected by titration with a potassium permanganate solution according to oxydol determination method described in the Japanese Pharmacopoeia.

[0071]

The results are shown in FIG. 12. In the case of the glass, the residual rate of hydrogen peroxide was less than 70%, while the residual rate regarding COP and COC were 70% or more. As a result, the COP and COC syringes were able to suppress the decomposition of hydrogen peroxide more than the glass syringe.

EXPLANATION OF REFERENCES

[0072]

1	Prefilled syringe
10	Syringes
20	Barrel
30	Needle mounting part
40	Cap
50	Hydrogen peroxide solution
60	Gasket
70	Plunger rod
80	Rod-inserted part
90	Flange
100	Nozzle
110	Nozzle part
111	Needle
112	Spray nozzle
112A	Outlet
112B	Orifice
112C	Inlet
120	Adapter part

200	Protector
300	Movable protector
310	Nozzle protection part
311	Groove
312	Front end of nozzle protection part
313	Rear end of nozzle protection part
314	Side wall of nozzle protection part
320	Support member
321	One end of support member
322	Other end of support member
330	Engagement part
340	Movable part
400	Slide-type protector
410	Nozzle protection part
411	Opening
412	Front end of nozzle protection part
413	Rear end of nozzle protection part
420	Support member
421	First arm
421A	One end of first arm
421B	Other end of first arm
422	Second arm
422A	One end of second arm
422B	Other end of second arm
430	Engagement part
441	First movable part
442	Second movable part
443	Third movable part
500	Syringe pump
501A	First surface of syringe pump
501B	Second surface of syringe pump
502A	First wall of syringe pump
510	Slit
520	Holder
530	Movable wall
540	Monitor

550	Switch
560	Processor
561	Memory
562	Pressure sensor
563	Battery
564	Electric motor
570A, 570B	Threaded rod

We claim:

1. A syringe comprising a portion thereof contacting a hydrogen peroxide solution, wherein the portion is made of cycloolefin polymer (COP) or cycloolefin copolymer (COC).
2. The syringe according to claim 1, wherein the syringe is suitable for prefilling with a hydrogen peroxide solution.
3. The syringe according to claim 2, further comprising the hydrogen peroxide solution in the syringe,
wherein the hydrogen peroxide solution comprises hydrogen peroxide and water.
4. The syringe according to claim 3, further comprises an additive.
5. The syringe according to any one of claims 1 to 4, further comprising a nozzle in a needle mounting part of the syringe.
6. The syringe according to claim 5, wherein the nozzle comprises a nozzle part and an adapter part connected to the needle mounting part of the syringe, and the nozzle part is a needle or a spray nozzle.
7. The syringe according to claim 6, wherein the needle has a groove with an echogenic pattern groove on an outer surface thereof.
8. The syringe according to claim 6 or 7, further comprising a protector, wherein the nozzle part is covered with the protector.
9. The syringe according to claim 8, wherein the protector comprises a support member, a nozzle protection part connected to one end of the support member, and an engagement part connected to the other end of the support member, and
the nozzle protection part comprises a space capable of accommodating the nozzle part.
10. The syringe according to claim 9, wherein the engagement part comprises a movable part and is movably connected to the other end of the support member via the movable part.
11. The syringe according to claim 9 or 10, wherein the space is positioned on a side wall of the nozzle protection part.
12. The syringe according to claim 9, wherein the support member comprises a first arm, a second arm, a first movable part, a second movable part, and a third movable part,
one end of the first arm is movably connected to the nozzle protection part via the first movable part,
the other end of the first arm is movably connected to one end of the second arm via the second movable part, and
the other end of the second arm is movably connected to the engagement part via the third movable part.
13. The syringe according to claim 10, wherein the movable part comprises a rail part connected to the nozzle protection part and a rail holding part connected to the engagement part, and

the rail holding part holds the rail part slidably.

14. The syringe according to claim 12 or 13, wherein the space is positioned inside the nozzle protection part, and

the nozzle protection part has a hollow structure.

15. The syringe according to any one of claims 1 to 14, further comprising a syringe pump.

16. The syringe according to any one of claims 1 to 15, wherein the concentration of the hydrogen peroxide in the hydrogen peroxide solution is 0.01 to 40% (w/v).

17. A kit comprising: the syringe according to claim 1, and a nozzle.

18. The kit according to claim 14, further comprising a protector for covering the nozzle part.