OPIC
OFFICE DE LA PROPRIÉTÉ INTELLECTUELLE DU CANADA

CIPO
CANADIAN INTELLECTUAL PROPERTY OFFICE

(12) (19) (CA) **Demande-Application**

(21) (A1) **2,307,658**
(86) 1998/10/09
(87) 1999/05/06

(72) CIRIGLIANO, MICHAEL CHARLES, US
(72) FRANKE, WILLIAM CONRAD, US
(72) KEMLY, MEGHAN MARY, US
(72) MCKENNA, RAYMOND THOMAS, US
(72) ROTHENBERG, PAUL JOHN, US
(71) UNILEVER PLC, GB

(51) Int.Cl.^{6} A23F 3/16, A23F 3/40
(30) 1997/10/28 (08/958,960) US

(54) **ACIDE CINNAMIQUE POUR BOISSONS A BASE DE THE**
(54) **CINNAMIC ACID FOR USE IN TEA CONTAINING BEVERAGES**

(57) La présente invention concerne des boissons à base aqueuse contenant des extraits de thé ainsi qu'une quantité suffisante d'acide cinnamique avec ses sels et ses esters, utilisé comme composé antimicrobien ou aromatique. Cette invention utilise une approche par paliers avec des niveaux sélectionnés de dureté de l'eau, de polyphosphate, d'agents chélatants, de correcteurs d'acidité, d'acide benzoïque et d'acide ascorbique pour empêcher le développement des germes dans la boisson, tout en lui conférant un arôme agréable. Ainsi, on obtient une boisson acceptable aussi bien du point de vue organoleptique que microbiologique.

(57) An aqueous based tea solids containing beverage is disclosed which also contains a sufficient amount of cinnamic acid its salts end esters as a flavouring/antimicrobial compound and employs a hurdle approach with selected levels of water hardness, polyphosphate, sequestrants, pH adjustment, benzoic acid and sorbic acid to prevent microbiological outgrowth while simultaneously contributing to the pleasant flavour of the beverage thus making the beverage acceptable both organoleptically and microbiologically.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A23F 3/16, 3/40	A1	(11) International Publication Number: WO 99/21431 (43) International Publication Date: 6 May 1999 (06.05.99)

(21) International Application Number: PCT/EP98/06635

(22) International Filing Date: 9 October 1998 (09.10.98)

(30) Priority Data:
08/958,960 28 October 1997 (28.10.97) US

(71) Applicant *(for AU BB CA CY GB GD GH GM IE IL KE LC LK LS MN MW NZ SD SG SL SZ TT UG ZW only)*: UNILEVER PLC [GB/GB]; Unilever House, Blackfriars, London EC4P 4BQ (GB).

(71) Applicant *(for all designated States except AU BB CA CY GB GD GH GM IE IL KE LC LK LS MN MW NZ SD SG SL SZ TT UG ZW)*: UNILEVER N.V. [NL/NL]; Weena 455, NL-3013 AL Rotterdam (NL).

(72) Inventors: CIRIGLIANO, Michael, Charles; Lipton, Division of Conopco, Inc., 800 Sylvan Avenue, Englewood Cliffs, NJ 07632 (US). FRANKE, William, Conrad; Lipton, Division of Conopco, Inc., 800 Sylvan Avenue, Englewood Cliffs, NJ 07632 (US). KEMLY, Meghan, Mary; Lipton, Division of Conopco, Inc., 800 Sylvan Avenue, Englewood Cliffs, NJ 07632 (US). MCKENNA, Raymond, Thomas; Lipton, Division of Conopco, Inc., 800 Sylvan Avenue, Englewood Cliffs, NJ 07632 (US). ROTHENBERG, Paul, John; Lipton, Division of Conopco, Inc., 800 Sylvan Avenue, Englewood Cliffs, NJ 07632 (US).

(74) Agent: BUTLER, David, John; Unilever plc, Patent Dept., Colworth House, Sharnbrook, Bedford MK44 1LQ (GB).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: CINNAMIC ACID FOR USE IN TEA CONTAINING BEVERAGES

(57) Abstract

An aqueous based tea solids containing beverage is disclosed which also contains a sufficient amount of cinnamic acid its salts end esters as a flavouring/antimicrobial compound and employs a hurdle approach with selected levels of water hardness, polyphosphate, sequestrants, pH adjustment, benzoic acid and sorbic acid to prevent microbiological outgrowth while simultaneously contributing to the pleasant flavour of the beverage thus making the beverage acceptable both organoleptically and microbiologically.

CINNAMIC ACID FOR USE IN TEA CONTAINING BEVERAGES

The present invention relates to the use of a natural or synthetically prepared flavourant material which also acts as an antimicrobial in aqueous based beverages containing tea solids. This material is trans cinnamic acid as well as its salts and esters.

Background and prior art

Acidified and native pH ready-to-drink (RTD) tea beverages, in the 2.5-6.5 pH range regardless of packaging are known to be susceptible to spoilage. As compared to cans, tea beverages packaged in glass and plastic bottles (because of increased O_2 ingress), as well as tea beverages at the higher range of the pH spectrum, are even more sensitive to yeast and mould spoilage than canned teas.

There are many different processes for preparing and packaging or bottling ready-to-drink (RTD) teas. For example, in one process the bottles can all be sterilised and the tea beverage first pasteurised and then bottled at high temperature. Each of these high temperature treatments requires a large capital investment for equipment and if there were many different bottling plants the costs of equipping each of these multiple plants with such high temperature equipment would be prohibitive if not impossible to justify.

Further all of these high temperature expedients are relatively inefficient and require a very high use of energy and excessive costs in addition to the original equipment costs. It is thus seen to be desirable to be able to prepare and bottle RTD teas without using such cost ineffective, energy intensive methods which also require a large initial investment in equipment.

This is particularly significant if bottling is scheduled to take place in a large number of preexisting bottling plants.

In an effort to overcome these problems a stepwise approach was taken. The principal requirement was to produce an excellent flavoured tea beverage which is microbiologically acceptable and which can be shipped and stored in a normal distribution chain through various warehouses and retail consumer outlets. These requirements must be met while keeping costs to a reasonable level and using pre-existing bottling plants. This in turn necessitates minimising capital investment in specialised equipment such as high temperature sterilising and pasteurising equipment and water treatment equipment such as reverse osmosis (RO) equipment.

Studies revealed that all of the above conditions could be satisfied by initiating a series of "hurdles" or steps each of which was designed to use existing equipment and resources. This could be accomplished within a reasonable cost while improving the microbiological stability of the tea beverage without deleteriously affecting its delicate flavour.

CA 02307658 2000-04-27

The steps include employing water having a very low water hardness; using a pH of about 2.5 to 4.0; using selected sequestrants with the pH and water adjustments; using selected polyphosphates in combination with the pH water and sequestrants; and using selected well known preservatives such as nisin, natamycin, sorbic acid and sorbates and benzoic acid and benzoates together with the low water hardness, the pH adjustment, sequestrants and polyphosphates. Together these steps contribute to this antimicrobial effect and thus individually each is incrementally antimicrobially effective.

Each of these steps produces at least incremental and frequently synergistic antimicrobial effects. None of them however contribute positively to the overall delicate flavour of the tea beverage, rather all of the steps taken are done to improve microbiological stability without negatively affecting the flavour. Thus the incrementally antimicrobially effective amount must take into account the flavour profile of the tea.

Many preservatives are readily available for many diverse uses. However natural compounds which are primarily flavourants are not usually considered for their antimicrobial activity.

There have been some attempts to use selected natural materials as preservatives. One of them is illustrated in Japanese Patent application 57/194,775 where cinnamic acid is used in combination with selected other organic acids including citric acid and sorbic acid.

United States patent 5,431,940 takes the approach of stabilising beverages by using water having a low degree of hardness in combination with other preservatives, and polyphosphates. The alkalinity is specified.

Tea containing beverages, because of their delicate balance of flavours require the utmost care in selecting preservatives. A fine balance must be achieved in stabilising teas without deleteriously affecting their flavour. Thus it is desirable to employ a natural compound as a flavourant which also may serve as an antimicrobial.

A method and composition is disclosed employing the stepwise or "hurdle" approach described above together with cinnamic acid for imparting a pleasant flavour to tea beverages while simultaneously contributing to the control of microbial growth in ready-to-drink still and carbonated tea beverages, for distribution and sale at ambient or chilled temperatures. The beverages include herbal teas, both "still" and carbonated as well as black, oolong and green tea. The method uses cinnamic acid in combination with the hurdle or step approach. This cinnamic acid compound may be natural or synthesised and may include reaction products of cinnamic acid such as esters and salts thereof.

The method, which also contributes to the stability of tea beverages employs trans cinnamic acid or 3-phenylpropenoic acid as well as reaction products such as salts and esters of the acid. Simple esters such as the methyl, ethyl and propyl esters are preferred.

This compound imparts pleasant or unique desirable and distinctive flavours to tea beverages when properly

AMENDED SHEET

combined. It also contributes to the stability of the beverage and may be used alone or in combination with mild heat treatments or reduced levels of traditional chemical preservatives such as sorbic and/or benzoic acid and their salts. It also contributes to antimicrobial activity at both ambient and chilled temperatures.

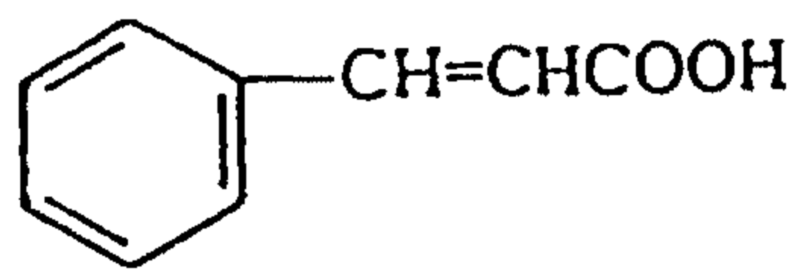
As mentioned above acidified and native pH based tea beverages including juice flavoured and juice containing tea beverages in the 2.5-7.0 pH range are known to be susceptible to spoilage by yeast, mould, acid tolerant bacteria (e.g. *Lactobacillus sp, Gluconobacter/Acetobacter sp.*) and/or mesophilic or thermophilic spore forming (e.g. *B. coagulans* and the *Alicyclobacillus sp.)* and non-spore forming bacteria. The compound of the invention 3-phenylpropenoic acid (i.e. trans-cinnamic acid), when formulated in the invention in combination with low levels of sorbic or benzoic acids and mixtures of these as well as other flavour components contributes to a pleasant unique, desirable and distinctive flavoured tea while adding the benefit of its antimicrobial activity. The compounds may be used at individual concentrations of preferably from about 25 to about 600 ppm and while used primarily as a flavourant have been found to be extremely effective antimicrobials. The compounds are effective against yeast, mould, and other acid tolerant and non-acid tolerant spore-forming and non-spore-forming spoilage bacteria in ready-to-drink tea beverages and tea beverages containing juice, fruit or vegetable extracts and/or additional flavours.

Higher levels of the compound of the invention up to about 2,000 ppm or higher may be used if desired.

The increased efficacy of this compound as an antimicrobial, relative to a simple phenolic acid like benzoic acid, is believed to be attributable to the presence of an unsaturated side chain. The efficacy of this side chain increases with the length of the side chain and the number of reactive double bonds contained in the same. The presence of these double bonds enhances the reactivity of the compound, internal to the microbial cell, after passive transport of the compound into the ceil. This is similar to the transport of benzoic acid into the cell. The subsequent combination effects of the dissociation of the acid moiety internal to the cell, and the accompanying presence of one or more highly reactive double bonds, contributes significantly to the antimicrobial effect observed.

The use of the disclosed compound, both naturally derived and synthetically prepared, provides a unique antimicrobial compound that may be used to formulate beverages which are "all-natural", by the current definition of the term. Pleasantly flavoured, ready-to-drink still and carbonated tea beverages that are stable and safe at ambient temperatures and/or that have an extended shelf life at chill temperatures are thus enabled.

A specific example of the compound is as follows:



Cinnamic Acid

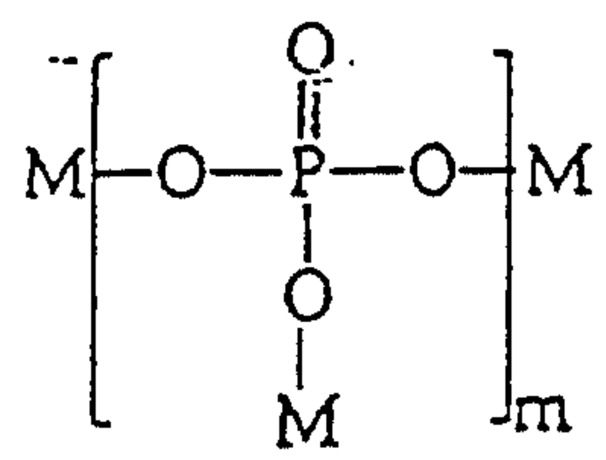
Trans cinnamic acid is preferred and selected salts and simple esters of cinnamic acid are also useful.

While not wishing to be bound thereby, it is theorised that the antimicrobial material operates as follows: Essentially the organism will typically passively transport the compound class described, in its non-dissociated (unchanged) state. Once the compound is in the cell it begins to dissociate, essentially upsetting the pH balance internal to the cell. An organism such as *Z. bailii*, one of the yeast species that poses a serious spoilage problem in beverages is reported to possess an ability to pump a preservative such as benzoic acid out quite readily thus, leading to *Z. bailii's* reputation as being somewhat preservative resistant. The compound of the present invention is less likely to succumb to the preservative pump because of added high reactivity of the unsaturated side chain. It is believed that for this reason the compound disclosed is effective.

In addition to the selected flavourant for tea beverages it is required to lower the pH to about 2.5 to 4.0 to improve the beverage stability. This is particularly useful when fruit juices or fruit flavours are employed in ready to drink tea beverages such as lemon flavoured tea beverages.

Further it has been found that the flavourant antimicrobial compound of the invention provides improved stability in tea beverages when the magnesium and calcium ions common to tap water are kept to no more than about 300 ppm as $CaCO_3$. Preferably the hardness is less than about 100 ppm and most preferably less than about 50 ppm or even lower such as 25 ppm or less. This can be achieved by deionization reverse osmosis or ion exchange in appropriate manner.

In addition it has been found that selected phosphates also contribute to stability and flavour and thus about 100 ppm to about 1000 ppm or higher and preferably about 250 to 500 ppm of a polyphosphate having the formula:



where m averages about 3 to 100 and M may be sodium or potassium.

Preservatives such as sorbic acid or sorbates and benzoic acid or benzoates or parabens used alone or in combination at levels of 50 to 1000 ppm are particularly beneficial without affecting flavour.

Additional sequestrants such as EDTA, NTA and the like have also been found to be useful in amounts of about 20 ppm up

AMENDED SHEET

to about 1000 ppm and preferably about 30 ppm to about 1000 ppm. When EDTA is used the lower levels are preferred. Many suitable sequestrants are listed in the Handbook of Food Additives, 2nd Edition, edited by Furia, CRC Press.

A preferred tea beverage of the invention has a water hardness of 10 ppm to 150 ppm measured as $CaCO_3$; a pH of less than 3.1; 100 to 1000 ppm of sodium hexametaphosphate; 10 to 75 ppm of EDTA; 50 to 1000 ppm of benzoic acid or benzoate; 50 to 1000 ppm of sorbic acid or sorbate; and 20 to 2000 ppm of a compound selected from the group consisting of cinnamic acid, cinnamic acid salts, cinnamic acid esters and mixtures thereof.

As used herein, the term "tea concentrate" refers to a product derived from concentrated tea extract which is mixed with water to form a drinkable tea beverage. The method of extraction is not significant and any method known in the art may be used.

As used herein, the term "tea beverage" refers to a drinkable beverage prepared from tea concentrates, extracts or powder. Usually the beverage is prepared by mixing with water. Various other flavouring agents and/or juices may also be included in the tea beverage such as fruit juices, vegetable juices and the like. If a concentrate or powder is used then the concentrate or powder is generally diluted with sufficient water to provide the tea beverage. Preferred tea concentrates or powders are typically diluted to about 0.06 to 0.4% tea solids, and preferably about 0.08 to 0.2% tea solids to provide a drinkable tea beverage but this depends on the flavour profile sought and amounts of 0.01 to 0.5% or higher may be used.

AMENDED SHEET

CA 02307658 2000-04-27

As used herein, the term "tea solids" refers to those solids normally present in a tea extract including normal tea antioxidants. Polyphenolic compounds are normally the primary component of tea solids when prepared from an extract of *Camellia sinensis*. However, tea solids can also include caffeine, proteins, amino acids, minerals and carbohydrates.

All parts and proportions herein and the appended claims are by weight unless otherwise indicated.

In order to demonstrate a stepwise or "hurdle" approach to achieving microbiological stability, several sets of experiments were run to establish the criticality of employing this approach. The individual steps are as follows:

1. water with a low water hardness;
2. pH control;
3. sequestrants including EDTA;
4. polyphosphate;
5. benzoate;
6. sorbate;
7. trans cinnamic acid.

A ready to drink (RTD) tea composition containing about 0.08% tea solids was prepared having the following general composition.

	%
K Benzoate	.03%
K Sorbate	.04%
Tea powder	.08%

AMENDED SHEET

CA 02307658 2000-04-27

Colour Component	.06%
Citric Acid	.07%
Lemon Flavour	.1%
HFCS (High Fructose Corn Syrup 55DE)	12%
Water balance to	100%

pH was adjusted to 2.8 with phosphoric acid.

EXAMPLE 1

Water hardness measured as $CaCO_3$ in the presence and absence of 30 ppm of EDTA was studied at different water hardness levels including 28 ppm; 36 ppm; 72 ppm and 138 ppm.

The RTD beverage was prepared as above at several water hardness levels and inoculated with *Z bailii*, preservative resistant spoilage yeast at a level of 10 colony forming units (CFU) per ml of beverage. The beverage was then bottled and observed for failure such as a plate count with at least a 2 log increase or "Frank Spoilage" such as for example CO_2 production or sediment or the like. Tabular results follow:

TABLE 1

Cumulative percent of bottles that have failed										
28 ppm water hardness										
	with EDTA					without EDTA				
Weeks	1	5	8	13	16	1	5	8	13	16
%	0	0	0	0	0	0	0	0	0	0

AMENDED SHEET

TABLE 2

Cumulative percent of bottles that have failed										
36 ppm water hardness										
	with EDTA					without EDTA				
weeks	1	5	8	13	16	1	5	8	13	16
%	0	0	0	0	3	0	0	0	0	5

TABLE 3

Cumulative percent of bottles that have failed										
72 ppm water hardness										
	with EDTA					without EDTA				
weeks	1	5	8	13	16	1	5	8	13	16
%	0	0	0	3	3	0	0	0	100	-

TABLE 4

Cumulative percent of bottles that have failed										
138 ppm water hardness										
	with EDTA					without EDTA				
weeks	1	5	8	13	16	1	5	8	13	16
%	0	11	73	83	87	0	100	-	-	-

These results clearly show that increasing water hardness reduces the microbial stability of the beverages and the addition of EDTA increases the microbial stability of the beverages. The addition of EDTA has been reported to destabilise the microbial cell wall and cell membrane. Accordingly, EDTA is theorised to have the effect of contributing to stability of the beverage by reducing water hardness, chelating metals and increasing the permeability of the microbial cell wall to preservatives by destabilising the wall and membrane.

EXAMPLE 2

A study was done to determine the impact of hexametaphosphate at a level of about 500 ppm at a pH of 2.8 and 3.2. An RTD beverage was prepared and bottled as in Example 1 except with EDTA at 30 ppm and water hardness at 50 ppm and inoculated with *Z bailii* at 1 CFU and 10 CFU except that the hexametaphosphate was either present or absent.

TABLE 5

pH 2.8 - 1 CFU - Cumulative % Failures					
weeks	2	4	6	8	10
sodium hexametaphosphate 0 ppm	8	100	-	-	-
sodium hexametaphosphate 500 ppm	0	0	3	84	100

TABLE 6

pH 2.8 - 10 CFU - Cumulative % Failures					
weeks	2	4	6	8	10
sodium hexametaphosphate 0 ppm	47	100	-	-	-
sodium hexametaphosphate 500 ppm	0	0	100	-	-

TABLE 7

pH 3.2 - 1 CFU - Cumulative % Failures							
weeks	1	2	3	4	6	8	10
sodium hexametaphosphate 0 ppm	0	0	89	100	-	-	-
sodium hexametaphosphate 500 ppm	0	0	3	100	-	-	-

TABLE 8

pH 3.2 - 10 CFU - Cumulative % Failures							
weeks	1	2	3	4	6	8	10
sodium hexametaphosphate 0 ppm	0	39	100	-	-	-	-
sodium hexametaphosphate 500 ppm	0	0	100	-	-	-	-

The results clearly show the enhancement in the delay of the onset of spoilage by the use of hexametaphosphate. Additionally this reinforces that lower pH contributes to the microbial stability of the beverage.

EXAMPLE 3

A study examined the effect of pH at 2.8 and 3.1 in the presence and/or absence of benzoic and sorbic acids. The RTD beverage was prepared and bottled as in Example 1 except 30 ppm of EDTA was added. The amount and presence of sorbic acid and benzoic acid was varied and the water hardness was set at 50 ppm. The inoculum used was 1 CFU/ml of beverage of *Z bailii* preservative resistant yeast:

Tabular results follow:

TABLE 9

Benzoic acid - 0 ppm Sorbic acid 200 ppm						
Cumulative % of Failures pH 3.1						
weeks	2	4	6	8	10	12
%	0	11	43	54	54	62
pH 2.8						
%	0	0	0	0	3	3

TABLE 10

Benzoic acid - 200 ppm Sorbic acid 0 ppm						
Cumulative % of Failures pH 3.1						
weeks	2	4	6	8	10	12
%	0	44	92	92	92	94
pH 2.8						
%	0	0	8	11	14	14

TABLE 11

Benzoic acid - 100 ppm Sorbic acid 100 ppm						
Cumulative % of Failures pH 3.1						
weeks	2	4	6	8	10	12
%	0	3	8	14	14	14
pH 2.8						
%	0	0	0	0	0	0

These results demonstrate the synergistic effect of the combination of sorbic acid benzoic acid as well as the effect of lower pH on microbial stability of the beverage.

EXAMPLE 4

A study was run to identify the effect of trans cinnamic acid on microbial stability in a tea system. The RTD beverage of Example 1 was used except that the pH is 3.0 and the water hardness is set at 72 ppm and 30 ppm EDTA was used. The inoculum was 1 CFU/ml of beverage of *Z bailii* preservative resistant yeast.

Tabular results follow:

TABLE 12

"Frank Spoilage" with and without t-cinnamic acid 125 ppm Cumulative % of failures						
pH 3.0						
weeks	2	4	6	10	12	14
with t-cinnamic acid - %	0	0	0	0	0	0
without t-cinnamic acid - %	0	0	18	45	45	47

The results show that trans cinnamic acid has a positive effect on microbial stability. The natural tea flavour/profile is enhanced by the presence of the trans cinnamic acid.

EXAMPLE 5

A study was done using t cinnamic acid and building on the sorbate, benzoate synergy shown in Example 3. The variants in Example 3 were repeated to determine whether trans cinnamic acid affords additional stability at lower preservative levels. The RTD beverage of Example 1 was prepared. 30 ppm of EDTA was added and the water hardness was 50 ppm. Additionally the amount and presence of sorbic acid and benzoic acid was varied, the pH was varied and the amount and presence of trans cinnamic acid was varied. 1 CFU/ml of *Z bailii* was used as an inoculum.

TABLE 13

Benzoic acid - 0 ppm Sorbic acid 200 ppm Cumulative % of failures						
pH 3.1						
weeks	2	4	6	8	10	12
t-cinnamic acid - 0 ppm %	0	11	43	54	54	62
t-cinnamic acid - 100 ppm %	0	0	3	3	3	3

TABLE 14

Benzoic acid - 200 ppm Sorbic acid 0 ppm Cumulative % of failures						
pH 3.1						
weeks	2	4	6	8	10	12
t-cinnamic acid - 0 ppm %	0	44	92	92	92	94
t-cinnamic acid - 100 ppm %	0	0	5	11	11	11

TABLE 15

Benzoic acid - 100 ppm Sorbic acid 100 ppm Cumulative % of failures						
pH 3.1						
weeks	2	4	6	8	10	12
t-cinnamic acid - 0 ppm %	0	3	8	14	14	14
t-cinnamic acid - 100 ppm %	0	0	0	5	5	5

TABLE 16

Benzoic acid - 0 ppm Sorbic acid 200 ppm Cumulative % of failures						
pH 2.8						
weeks	2	4	6	8	10	12
t-cinnamic acid - 0 ppm %	0	0	0	0	3	3
t-cinnamic acid - 100 ppm %	0	0	0	0	0	0

TABLE 17

Benzoic acid - 200 ppm Sorbic acid 0 ppm Cumulative % of failures						
pH 2.8						
weeks	2	4	6	8	10	12
t-cinnamic acid - 0 ppm %	0	0	8	11	14	14
t-cinnamic acid - 100 ppm %	0	0	0	0	0	0

TABLE 18

Benzoic acid - 100 ppm Sorbic acid 100 ppm Cumulative % of failures						
pH 2.8						
weeks	2	4	6	8	10	12
t-cinnamic acid - 0 ppm %	0	0	0	0	0	0
t-cinnamic acid - 100 ppm %	0	0	0	0	0	0

The results clearly demonstrate the effectiveness of trans cinnamic acid to stabilise beverages at a reduced preservative level as well as the overall effect of the "hurdle' approach. The improved flavour profile of beverage with trans cinnamic acid used to lower the preservative level is quite noticeable.

CA 02307658 2000-04-27

CLAIMS

1. An aqueous based tea beverage containing a compound selected from the group consisting of cinnamic acid, cinnamic acid salts, cinnamic acid esters and mixtures thereof, said beverage having been prepared with a series of control steps consisting essentially of incremental pH control, incremental addition of hexametaphosphate, incremental addition of sorbic acid, incremental addition of benzoic acid, incremental addition of EDTA and incremental water hardness control to stabilise said beverage, said compound being present in the beverage in an antimicrobial effective amount in combination with said control steps and said compound being capable of having a selective flavouring effect on said beverage.

2. An aqueous based beverage comprising 0.01% to 0.5% tea solids by weight and a sufficient amount of cinnamic acid, its salts and esters in combination with hurdles as defined in claim 1 to prevent microbial spoilage.

3. A beverage as defined in claim 1 or 2 wherein said cinnamic acid is present in an amount of 25 to 600 ppm.

4. A beverage as defined in any preceding claim having a sufficient amount of said cinnamic acid in combination with said incremental control steps to completely inhibit the outgrowth of yeast, mould and other microbes.

5. A beverage as defined in any preceding claim further comprising sufficient tea solids to result in an antioxidant effect.

AMENDED SHEET

CA 02307658 2000-04-27

6. A beverage as defined in any preceding claim further comprising a flavouring agent and/or fruit or vegetable juice or extract in addition to tea.

7. A beverage as defined in claim 1 wherein said cinnamic acid is natural.

8. A beverage as defined in claim 1 wherein said cinnamic acid is synthetic.

9. A beverage as defined in claim 1, wherein said cinnamic acid is trans cinnamic acid.

10. A method for improving the microbiological stability of a tea beverage without negatively affecting the flavour of said beverage comprising the steps of:

controlling the water hardness of said beverage to an antimicrobial level;

controlling the pH of said beverage to an incrementally antimicrobial level;

adding an incrementally antimicrobial effective amount of polyphosphate to said beverage;

adding an incrementally antimicrobial effective amount of a sequestrant other than polyphosphate to said beverage;

adding an incrementally antimicrobial effective amount of benzoic acid or benzoate to said beverage;

AMENDED SHEET

CA 02307658 2000-04-27

adding an incrementally antimicrobial effective amount of sorbic acid or sorbate to said beverage;

adding an incrementally antimicrobial effective amount of cinnamic acid to said beverage, whereby the total amount of incremental additives is sufficient to constitute an antimicrobially effective amount in said beverage.

11. A method for improving the microbiological stability of an aqueous based tea beverage comprising:

controlling the water hardness of the beverage to a level of less than 100 ppm measured as $CaCO_3$;

controlling the pH of the beverage to between 2.5 and 4.0;

adding at least 100 ppm of polyphosphate to said beverage;

adding at least 20 ppm of sequestrant other than polyphosphate to said beverage;

adding at least 50 ppm of benzoic acid or benzoate to said beverage;

adding at least 50 ppm of sorbic acid or sorbate to said beverage;

adding to said beverage 25 to 600 ppm of a compound selected from the group consisting of cinnamic acid; cinnamic acid salts, cinnamic acid esters and mixtures thereof.

AMENDED SHEET

CA 02307658 2000-04-27

12. An aqueous based tea beverage having a water hardness of 10 ppm to 150 ppm measured as $CaCO_3$; a pH of less than 3.1; 100 to 1000 ppm of sodium hexametaphosphate; 10 to 75 ppm of EDTA; 50 to 1000 ppm of benzoic acid or benzoate; 50 to 1000 ppm of sorbic acid or sorbate; and 20 to 2000 ppm of a compound selected from the group consisting of cinnamic acid, cinnamic acid salts, cinnamic acid esters and mixtures thereof.

AMENDED SHEET