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Declarations under Rule 4.17:

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(54) Title: TOMATO PRODUCT AND METHOD FOR OBTAINING SAME

(57) Abstract: A tomato product with Brix similar to the Brix of a raw tomato; lycopene content in the range of 600% to 1200% of that of a raw tomato, and viscosity of 3 to 14 cm according to the Bostwick analysis method.



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- *of inventorship (Rule 4.17(iv)) for US only*

- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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Tomato Product and Method for Obtaining Same

Field of the Invention

The present invention relates to the field of tomato products. Particularly, to a novel
5 tomato product and a method for obtaining it.

Background of the Invention

The most common and basic industrial products made of tomatoes are tomato
concentrates which contain at least 24% soluble solids. This family of products has a
10 standard of identity set by the United States Department of Agriculture (USDA) and can
be described as: the products which are obtained by extracting liquid from tomatoes,
free from seeds and skin and removing part of the water by evaporation up to a defined
range of concentration. The concentration is expressed in units of "Brix" or "total
soluble-solids", both represent the percentage of soluble solids in the liquid phase, or
15 more accurately defined as the measure of the total soluble solids, expressed as if they
were sucrose, measured by means of a refractometer.

The total soluble solids (TSS) of a fresh tomato is about 5° Brix. Most of the industrial
tomato concentrates are in the range of 28°-32° Brix and they are classified as tomato
20 paste. It is ,therefore, understood that to obtain for example, one measure of 30 Brix
paste, requires 6 measures of fresh tomatoes.

The basic process to produce tomato paste is as follows: Fresh tomatoes are washed,
sorted to remove unsuitable fruit, crushed and heated to 65°-95° C, then the crushed
25 tomatoes are strained to remove seeds and skins to obtain the liquid. The liquid is
concentrated by removing water usually in a thermal evaporator which cooks the liquid
under vacuum, thus creating boiling at reduced temperature. The vapors generated are
removed by condensation until the desired Brix is reached. The average conditions of
the concentration process are temperature of 70° C and residence time of 2-3 hours
30 (Moresi, M. and Liveroti, C.; "Economic study of tomato production", *J. Fd. Technol.*,
(1982) 17, 177-192). The evaporation process under heat causes the paste to differ from

the fresh raw material in the following manner, as described by Buttery *et al*, *J. Agri. Food Chem.*, (1990) **38**, 336-340; Barreiro *et al*, *J. Food Engineering*, (1997) **33**, 359-371 and in the *White Book on the Antioxidants in Tomatoes and Tomato Products and Their Health Benefits*:

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a) Most of the aroma and flavor constituents are stripped in the process.

b) The color of the paste is degraded due to partial oxidation of the lycopene, as well as browning due to excessive heating.

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c) The taste of the paste has some cooked off-flavor.

d) Nutritional elements such as lycopene and vitamins such as vitamin-C, and thiamine are partially destroyed by oxidation which is accelerated under heat.

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Starting from tomatoes containing about 70-100 ppm lycopene and 5° Brix, the tomato concentrate obtained having 30° Brix will normally contain 350 – 400 ppm, which is equivalent to about 63%-83% lycopene recovery.

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Tomato paste has many uses in numerous products and dishes. Its function as a food ingredient can be summarized as:

a) Contributing the tomato taste and flavor.

b) Giving the red color to the product or dish.

c) Contributing to the texture of the product.

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Therefore, the main quality parameters under which tomato paste is tested are: color, viscosity, flavor and lycopene content, in addition to other parameters such as Brix and pH.

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In view of the aforementioned there is a long felt need for a tomato product which provides the functions of tomato paste without the aforementioned shortcomings of

tomato paste.

It is therefore a purpose of the present invention to provide a tomato product with improved properties over tomato paste, particularly with respect to flavor, lycopene content and color.

It is further a purpose of the present invention to provide a process for the preparation of a tomato product with improved properties.

Other objects of the invention will become apparent as the description proceeds.

Summary of the Invention

The present invention provides a tomato product with Brix similar to the Brix of a raw tomato; lycopene content in the range of 600% to 1200% of that of a raw tomato, and viscosity of 3 to 14 cm according to the Bostwick analysis method.

The present invention further provides a tomato product with Brix of 4° to 6°, preferably about 5°; lycopene content of 300 to 1500 ppm, and viscosity of 3 to 14 cm according to the Bostwick analysis method.

Further provided by the present invention is a method for obtaining the tomato product of the present invention, comprising of controlling the ratio between tomato pulp and a liquid fraction of the tomato, wherein said liquid fraction may be tomato juice or tomato serum, and the ratio between the tomato pulp and liquid fraction is in the range of 1:1 to 1:3.

Further provided by the present invention is the use of the claimed tomato product as a flavoring and texturing agent, and as a source of lycopene wherein said product is of reduced caloric value.

Detailed Description of a Preferred Embodiment of the Invention

The following description is illustrative of embodiments of the invention. The following description is not to be construed as limiting, it being understood that the skilled person may carry out many obvious variations to the invention.

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Throughout the description, percentage of components and ratios are by weight. Furthermore the terms "tomato paste" and "tomato concentrate" are synonymous.

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The present invention provides a novel approach to the concentration of tomato products. The invention concentrates the functional elements of the tomato in a non-thermal process, by separation of said elements, while traditionally tomato concentrates are prepared by water removal. Said novel approach demonstrates a method according to which the correlation between viscosity and Brix of a tomato product is not constantly proportional. For purposes of the present invention, the viscosity of the tomato product has been determined relatively to other tomato concentrates or pastes by a modified Bostwick analysis method as described in the Examples. Throughout the description and claims Bostwick method means the modified Bostwick method described herein.

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According to the present invention there is provided a tomato product with Brix similar to the Brix of a raw tomato; lycopene content in the range of 600% to 1200% of that of a raw tomato, and viscosity of 3 to 14 cm according to the Bostwick analysis method. Hence, the raw tomato employed for the purpose of obtaining the tomato product of the present invention is material in determining the Brix and lycopene content of the tomato product. Accordingly, the properties of the tomato product may also be controlled by the variety of tomato employed for obtaining the tomato product.

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According to a particular embodiment of the present invention the tomato product has the following properties:

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- 1) Brix of 4° to 6°.
- 2) Lycopene content of 300 to 1500 ppm.

3) Viscosity of 3 to 14 cm according to the Bostwick analysis method.

Tomato paste is used in food stuff mainly to provide one or more of the following functions: to add color, taste and texture; to control viscosity; and as a source of lycopene. The present tomato product provides all of the aforementioned functions, and for several of said functions has been found to be superior to tomato paste.

As a color and source of lycopene, the tomato product of the present invention provides a more intense red color than tomato paste and higher lycopene levels. Furthermore, the methods for preparing tomato paste include heat treatment at temperatures which may cause degradation of the lycopene, hence, adversely effecting the red color and lycopene content of the paste. The present tomato product is not subjected to such treatment.

As a texturizing and viscosity-controlling agent the present tomato product is as effective as tomato paste. Said properties of the tomato product can easily be controlled by adjusting the ratio between the pulp and the liquid fraction.

The present tomato product is not subjected to conditions which may damage the natural tomato flavor, e.g. prolonged exposure to heat. Hence, in terms of taste, the tomato product provides a flavor closer to the flavor of a fresh tomato than the flavor provided by tomato paste.

Thus, it is clearly evident that the present tomato product can be used as a substitute for tomato paste and even provide superior performance in comparison to tomato paste in terms of color, taste and lycopene content. An important feature of the present invention is found in the fact that the soluble solids content of the tomato product is only about 15% to 20% of the soluble solids content of tomato paste. Said soluble solids provide a substantial part of the caloric value of tomato concentrates, thus the present tomato product has a substantially reduced caloric value in comparison with tomato paste.

According to a further embodiment of the present method the tomato product is prepared by combining tomato pulp with tomato juice wherein the weight ratio pulp:juice is between 1:1 to 1:3. The desired properties of the tomato product may be controlled by said ratio, e.g. higher viscosity would require less juice. Tomato juice may be obtained according to methods well known in the art. The pulp may be obtained according to the process described in U.S. patent No. 5,837,311, incorporated herein by reference. Pulp is obtained from straining the tomato through a strainer with holes ranging in the size of 1.5-1.6 mm.

According to a preferred embodiment of the present invention the pulp and juice are combined at a pulp to juice ratio of 1:1 to 1:2, preferably about 1:1.5.

According to yet a further embodiment of the present method, the tomato product claimed herein may be obtained by removal of serum from the tomato such that the desired weight ratio between the tomato pulp and serum is achieved. Said ratio being in the range of 1:1 to 1:3. The method may be carried out under modified conditions of certain stages of the process described in U.S. patent No. 5,837,311. Accordingly, controlling the conditions of the separation between the pulp and the serum, for example by decantation, enables the skilled artisan to obtain the tomato product. The amount of serum separated from the pulp controls the properties of the tomato product obtained therefrom. According to the present embodiment, the tomato product is obtained in the pulp fraction of the separation process.

In yet a specific embodiment of the present invention, the tomato product is obtained in a form wherein the pulp is a crude pulp. Crude pulp is obtained wherein the tomatoes have been strained through a strainer with holes in the range of 4-8 mm. The crude pulp may contain seeds and some of the tomato skin. A tomato product containing crude pulp is particularly useful in preparing tomato sauce for pizza and the like.

An additional advantage of the present process is derived from the low energy requirements. To produce one metric ton of 30° Brix tomato paste in the classical

thermal evaporation system requires about 1,000,000 kcal. While to produce one metric ton of the tomato product requires only 65,000 kcal. Since a predominant part of the commercial evaporation systems in the tomato paste industry employ steam as a heat source, approximately 300 lbs. of heavy oil are burnt in the steam boiler for each metric ton of tomato paste, compared to 20 lbs. only for producing one metric ton of the tomato product. This significantly lowers process costs and has an important environmental impact by significantly reducing environmentally damaging emissions.

Examples

Example 1: Preparation of the Tomato Product

Raw fresh tomatoes are washed, sorted, crushed and strained to remove seeds and skins, and are then transferred to a feed tank. The strained crushed tomatoes are heated to a temperature in a range of 65 to 95°C for a very short time, about 1 to 6 minutes, and then centrifuged to separate into two streams: a clear or semi clear serum and pulp. The serum is composed primarily of acids, sugars, amino acids, minerals and some of the flavor constituents dissolved in water. The pulp contains insoluble tomato solids, lycopene, tocopherols and other tomato phytonutrients, as well as small amounts of serum. The ratio of the separation process is :6-7 % pulp and 93-94 % Serum. The serum part is a by-product and has several uses as a food ingredient and as a source of tomato soluble solids in foods and beverages. The pulp and tomato juice are blended and mixed in ratios of 1:1 to 1:3. The ratio controls the viscosity of the product and the composition of some of the tomato components.

Example 2: Preparation of the Tomato Product

Raw fresh tomatoes are washed, sorted, crushed and strained to remove seeds and skins, and are then transferred to a feed tank. The strained crushed tomatoes are heated to a temperature in a range of 65 to 95°C for a very short time, about 1 to 6 minutes, and then centrifuged under controlled conditions to separate into two streams: a clear or semi clear serum and pulp. Centrifugation is continued until the desired consistancy is obtained. The properties of the tomato product are controlled by the ration between the serum and pulp.

Example 3: Determining viscosity of the tomato product

The viscosity of the tomato product of the present invention is determined according to a procedure which is a modified form of the Bostwick method. The principle of the Bostwick method is based on the measurement of the distance a standard sample of product is travels along a inclined surface in 30 seconds.

Apparatus - Bostwick consistometer;

The apparatus comprises of a stainless steel slide with balancing legs, approximately 24 cm long. The sample is put in front of the slide in a 100 gr. capacity cell equipped with a spring gate. The slide has a ruler imprinted on it with measures in centimeters.

Sample:

The paste is diluted with water down to 12.5° Brix, maintained at a temperature of 24°C and a portion of 100 gr is put in the instrument's cell. In order to measure the relative viscosity of the tomato product, it cannot be diluted to 12.5° Brix since the Brix of the tomato product is only 4 to 6. Thus, the tomato product is diluted with water in identical proportions to the dilution of the paste and maintained at the same temperature.

Measurement:

A stop watch is started and the gate is opened. After 30 seconds the distance which the sample has run on the slide is taken and this is the viscosity value of the sample expressed in centimeters.

Generally, very viscous tomato paste has a Bostwick value of 4 to 5 cm; paste of medium viscosity has a Bostwick value of 5-7 cm; and low viscosity paste would have values of 8 cm and above.

When measuring viscosity of a 30° Brix paste, the dilution ratio with water to prepare the sample is 1:2.4 (from 30° Brix to 12.5° Brix). Therefore, it is suggested, that in order to compare the viscosity of the tomato product with the viscosity of standard tomato

paste, the tomato product should be diluted with water by the same ratio and then measured in the Bostwick instrument under the same conditions.

Viscosity measurements of the tomato product:

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Ratio Pulp: Juice	Viscosity
1:1	4 – 5
1:1.25	5 – 6
1:1.5	6-7
1:2	8 – 10

While embodiments of the invention have been described by way of illustration, it will be apparent that the invention may be carried out with many modifications, variations and adaptations, without departing from its spirit or exceeding the scope of the claims.

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CLAIMS

1. A tomato product with Brix similar to the Brix of a raw tomato; lycopene content in the range of 600% to 1200% of that of a raw tomato, and viscosity of 3 to 14 cm according to the Bostwick analysis method.
2. A tomato product according to claim 1 wherein the Brix is 4° to 6°, lycopene content is 300 to 1500 ppm, and viscosity is 3 to 14 cm according to the Bostwick analysis method.
3. A tomato product according to claim 2 wherein the Brix is 5°, lycopene content is 350 to 800 ppm, and viscosity is 4 to 10 cm.
4. A tomato product according to claim 1 wherein said product is a combination of tomato serum and tomato pulp.
5. A tomato product according to claim 1 wherein the said product is a combination of tomato pulp and tomato juice.
6. A tomato product according to claims 4 and 5 wherein the pulp is crude pulp.
7. A method for obtaining the tomato product of claim 1, comprising of controlling the weight ratio between tomato pulp and a liquid fraction of the tomato, wherein said liquid fraction may be tomato juice or tomato serum, and the ratio between the tomato pulp and liquid fraction is in the range of 1:1 to 1:3.
8. A method according to claim 7, comprising of combining tomato pulp with tomato juice wherein the weight ratio between the tomato pulp and tomato juice is in the range of 1:1 to 1:3.

9. A method according to claim 7 comprising of ;

- a) washing and sorting fresh tomatoes,
- b) crushing and straining the tomatoes to remove seeds and skins,
- c) separating the serum from the strained tomatoes until the weight ratio between
5 the pulp and serum is in the range 1:1 to 1:3.

10. A method according to claim 9 wherein the separating of the serum from the strained tomatoes is by centrifugation or decantation.

10 11. Use of the tomato product of claim 1 as a flavoring agent.

12. Use of the tomato product of claim 1 as a texturing agent.

13. Use of the tomato product of claim 1 as a source of lycopene.

15 14. Use according to any one of claims 11 to 13 wherein said product is of reduced caloric value.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A23L1/212

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A23L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPO-Internal, WPI Data, PAJ, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 837 311 A (RAVEH YIGAL ET AL) 17 November 1998 (1998-11-17) cited in the application column 2, line 26 - column 3, line 56 -----	1-14
X	US 4 670 281 A (BRADLEY DONALD B) 2 June 1987 (1987-06-02) column 4, line 15 - column 5, line 15 examples ----- -/--	1-14

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

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T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search

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Name and mailing address of the ISA

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	TRIFIRO A ET AL: "Temperature effects on rheological parameters of vegetable food fluids in relation to their pulp contents." INDUSTRIA CONSERVE, vol. 69, no. 2, 1994, pages 139-147, XP0008021475 ITALY page 140, right-hand column	1-5,7,8
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