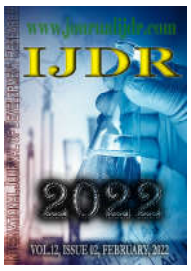
ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 12, Issue, 02, pp. 53855-53858, February, 2022
https://doi.org/10.37118/ijdr.23942.02.2022



RESEARCH ARTICLE OPEN ACCESS

POSSIBLE INDUSTRIAL APPLICATIONS OF PASSION FRUIT OIL

Marta Bernardo Cesar*[1]; Sandra Maria Barbalho[1,2,3]; Alda Maria Machado Bueno Otoboni[1]; Karina Quesada[1,2]; Rakesh Kumar Joshi[4]; Adriana Maria Ragassi Fiorini[1]; Claudia C. Teixeira Nicolau[1]; Lucas Fornari Laurindo[2]; Marie Oshiiwa[1]; Adriano Cressoni Araújo[2,3]; Claudia Rucco P. Detregiachi[3]; Úrsula Girotto Marinho Spinola[3] and Elen Landgraf Guiguer[1,2,3]

[1]School of Food and Technology of Marilia (FATEC) – Marilia – SP, Brazil; [2]Department of Biochemistry and Pharmacology, School of Medicine, University of Marília (UNIMAR), Avenida Higino Muzzi Filho, 1001, Marília, São Paulo, Brazil; [3]Postgraduate Program in Structural and Functional Interactions in Rehabilitation - UNIMAR - Marília – SP, Brazil; [4]Department of Education, Government of Uttarakhand, India; [5]Department of Animal Sciences, School of Veterinary Medicine, University of Marília (UNIMAR), Avenida Higino Muzzi Filho 1001, Marília 17525-902, São Paulo, Brazil

ARTICLE INFO

Article History:
Received 02nd November, 2021
Received in revised form
16th December, 2021
Accepted 28th January, 2022
Published online 20th February, 2022

Key Words:
Passion fruit; Oil;
Industrial applications.

Corresponding author:
Marta Bernardo Cesar

ABSTRACT

Passion fruit belongs to the genus *Passiflora*, family Passifloraceae, with more than 500 species. The seeds represent an important source of essential polyunsaturated fatty acids. However, they are routinely discarded and discarded soon after processing to obtain the pulp leading to environmental issues. The oil is extracted from the passion fruit seed and contains valuable bioactive. Due to the antioxidant and anti-inflammatory actions of these compounds, the oil could have a role to prevent the development of numerous health conditions. Due to the above, this study aims to perform a review on the applications of passion fruit seed oil. The oil extracted from the passion fruit seed presents several benefits and can be used in different ways, mainly because it is a residue that contains a good amount of omega 6. In the food industry, it can be used to manufacture juices and jellies. The defatted pie also has a high added value, as it is rich in proteins and fibers, thus being an excellent option for the veterinary industry to be used as an ingredient in animal feed. In the pharmaceutical area, it is attractive in the formulation of creams and shampoos. Passion fruit seed oil has valuable bioactive compounds with high concentrations of bioactive compounds with antioxidant and anti-inflammatory actions. The search for these benefits is increasing sharply in processed food and pharmaceutic compounds.

Citation: ***Marta Bernardo Cesar; Sandra Maria Barbalho; Alda Maria Machado Bueno Otoboni; Karina Quesada et al.*** "Possible industrial applications of passion fruit oil*", International Journal of Development Research*, 12, (02), 53855-53858.

INTRODUCTION

Passion fruit belongs to the genus Passiflora, family Passifloraceae, which has more than 500 species, of which at least 50 have commercial potential. The fruit is found in the Caribbean, south Florida, South America, South Africa, and Asia. In Brazil, there are about 120 native species. The most known species in cultivation and commercialization are *Passiflora edulis* due to the quality of the fruits (Silva *et al*., 2015; Cheok *et al*., 2018; de Araújo Esteves Duarte *et al*., 2021). Passiflora edulis also stands out due to its medicinal importance. Many varieties are found such as P. edulis f. edulis, P. edulis f. flavicarpa, P. edulis Sims, P. edulisvar.kerii,P. edulisvar. pomifera, P. edulisvar. rubricaulis, and P. edulisvar.verrucifera. The yellow-fruited variety P. edulisf.flavicarpa and the purple-fruited type, P. edulis Sims are most common varieties with economic importance. The fruit is formed by peel (50.5%), pulp (29%) and seeds (20.5%). The yellow fruit is 4–7 cm in diameter and 6–12 cm long; the peel is yellow and thick. The seeds are dark brown. The pulp presentsan acidic and strong aromatic flavor. The purple fruit is 3.5–7 cm in diameter and 4–9 cm long; the peel is purple, and the seeds are black (Cazarin *et al*., 2016; He, X. *et al*., 2020). Tre fruit is mainly consumed in its fresh form, or as juices, sweets, jellies, and ice cream. Passion fruit is a good source of provitamin A, niacin, riboflavin, and ascorbic acid with great nutritional value. Passiflora species are rich in flavonoids, which produce anxiolytic activity (He, X. *et al*., 2020; Matsumoto e Katano, 2021).Other medicinal properties are also observed in the leaves, such as sedative capacity and hypoglycemic and hypolipidemic activities observed from the use of the flour prepared from the epicarp of the fruit (Barbalho *et al*., 2011; Barbalho

et al., 2012; DE Souza *et al*., 2012). Seeds represent an important source of essential polyunsaturated fatty acids. However, they are routinely discarded and discarded soon after processing to obtain the pulp. Its lipid content varies between 18% – 29%, with a predominance of linoleic (55-66%), oleic (18-20%) and palmitic (10-14%) acids. The variation observed in the percentage of lipids, and their chemical composition derives from climatic factors, environment, growing location, cultivated variety, and planting conditions (Regis *et al*., 2015). The oil is extracted from the passion fruit seed and contains valuable bioactive compounds. Studies report concentrations of tocopherols, carotenoids, phenolic compounds (Malacrida *et al*., 2012). Due tothe antioxidant and anti-inflammatory actions of these compounds, the oil could have a role to prevent the development ofnumerous health conditions, such as cardiovascular diseases, which are among the main causes of death worldwide (Nascimento *et al*., 2021; Pérez-Gregorio; Simal-Gándara, 2017; Pertuzatti *et al*., 2015). In addition to the benefits described above, there is perspective of several business possibilities to be explored from the application of passion fruit seed oil in the food industry, mainly because it is a residue that contains a good amount of omega 6, which is widely used in the manufacture of industrial products. In addition to the pie, which also has high added value, as it is rich in protein and fiber and can be used as an ingredient in food products (Piombo *et al*., 2006; Zeraik *et al*., 2010). Despite passion fruit's economic and functional importance, the concentrated juice industry uses only pulp, which represents only 30% of the total fruit mass. The indiscriminate disposal of other parts, mainly the bark, albedo, and seeds, generates tons of waste. However, depending on the fruit, such residues may contain equal or greater amounts of nutrients than the pulp. Adding value to these by-products, in addition to reducing the environmental impact, results in technological, scientific, and economic benefits (Barrales, 2015). The oil is extracted from the seeds is yellow in color, with a pleasant taste and mild odor. The pie resulting from the oil extraction is a source of fiber and proteins. Moreover, it is rich in antioxidant compounds and can be used as an ingredient in various food uses (LOPES *et al*., 2010; MALACRIDA *et al*., 2012). Of high nutritional and technological value, in the oil composition presents predominantly unsaturated fatty acids, mainly oleic and linoleic acids, which are demanded by the food industry in the formulation of jams and ice cream, in pharmaceutical products, in cosmetics in perfumes and aromas and energy in the refining of biodiesel. The seeds are also rich in pectin, allowing the use in animal feed. The percentage of oil corresponds to about 25.7% of the weight of the dry bran obtained, with a high content of unsaturated fatty acids, which reaffirms the potential for use both in human and animal food and in cosmetic use (Ferrari *et al*., 2004). Due to the above, this study aims to perform a review on the applications of passion fruit seed oil.

METHODS

PUBMED, Google Scholar, andScielo databases were consulted.The descriptors were passion fruit oil and industrial application or industry.

RESULTS AND DISCUSSION

Passiflora Seeds: The composition of purple passion fruit was evaluated in a study and showed a high content of anthocyanins in the peels and seeds. The yellow passion fruit showed higher amounts of pectin in the skins, high levels of carotene, quercetin and kaempferol in the pulps and higher amounts of total fiber in the seeds (HE, XIRUI *et al*., 2020). Passion fruit seeds (*Passiflora edulis* Sims var. *edulis*) were evaluated by DEWI *et al*., (Dewi *et al*., 2020), who found high levels of linoleic acid and piceatannol. Also according to the authors, the substances detected were related to antibacterial, anti-inflammatory, and antioxidant activities promoted by the extracts obtained from the seeds, with a significant improvement in the treatment of acne vulgaris. Maruki-Uchida *et al*. (Maruki-Uchida *et al*., 2018) verified in their studies that the ingestion of passion fruit seed extracts can improve the quality of the skin, with a decrease in fatigue and an increase in humidity, due to the presence of the piceatannol compound. ISHIDA E FURUYA (ISHIDA e FURUYA, 2021), tested 19 bacterial strains to verify the action of piceatannol and resveratrol as defense compounds and observed that piceatannol had a bacteriostatic effect on most of the bacteria tested. SILVA *et al*.(SILVA *et al*., 2020) showed that the seeds of passion fruit and watercress leaves produced volatile organic compounds with nematicidal activity for *Meloidogyne icognita*.

Passiflora Seeds Oil: general comments and extraction: Passion fruit oil has a high content of unsaturated fatty acids, has a yellow color, pleasant flavor, mild odor, and low stability due to the linoleic acid content (ω-6), of approximately 69%. The passion fruit husks and seeds correspond to approximately 70% of the fruit's weight - the rind has about 60% and the seed 10% of the total weight(FERRARI *et al*., 2004). Therefore, it is necessary to find reuse alternatives to add value to these by-products of technological, scientific, and economic interest. The seeds, which are rich in polyunsaturated fatty acids essential in the human diet, deserve relevant attention. Studies carried out with passion fruit seeds suggest that they are a noble source of edible oil with different levels of unsaturated fatty acids. However, due to the high degree of unsaturated fatty acids,the oil has low oxidative stability, reducing its application in different products (Barrales, 2015). The quality of the oil is mainly determined by components like lipids and minor components whose levels are influenced by different factors such as environmental and genetic (Lucarini *et al*., 2019). Obtaining the oil from the seed begins with cleaning with warm water (60°-70°C), drying at a maximum temperature of 70°C, milling, rolling, cooking (pre-heating), pressing or solvent extraction (GARCIA, 1980). Ferrari *et al* (Ferrari *et al*., 2004) used hexane as a method to extract passion fruit seed oil, using hexane in a Soxhlet type extractor, with the solvent evaporated by a rotary evaporator, obtaining a percentage of 25.7% in mass of the dry bran weight. Vieira (VIEIRA, 2006) also used hexane to extract passion fruit (*Passiflora edulis*) seed oil obtained very similar results (25.6%).

LOPES *et al* (LOPES *et al*., 2010) carried out the extraction with petroleum ether at 40-60 ºC in a fat extractor, with a solvent totally evaporated under vacuum, obtaining a percentage of 27.3-28.0% by mass of the passion fruit dry meal weight. In this study, the authors used the scanning optical microscopy technique to evaluate the morphology of microparticles produced by spray drying, with three magnifications for each combination of wall material, 1000, 3000 and 7000 times. According to the author, in general, no morphological differences were observed between the microparticles due to different drying temperatures or homogenization methods (rotor-stator and ultrasound). The microencapsulation technique can be an alternative to avoid oil exposure to atmospheric air, protecting and inhibiting the oxidative deterioration of lipids, and preventing the production of unpleasant taste and odor. In the food industry, this technique reduces limitations in the use of ingredients, reduces volatility and reactivity, and increases their stability in adverse environmental conditions, such as in the presence of oxygen, extreme pH and light(BRASIL, 2013).
According to DELFINI(DELFINI, 2016), in general, the microencapsulation of passion fruit seed oil increased the induction time between 3 and 4 times, resulting in greater protection of the particles against oxidation, proving that microencapsulation is a good alternative to increase the stability of the oil. In this study, the microencapsulation of passion fruit seed oil proved to be a good alternative for protecting the oil against oxidation, enabling an increase in shelf life, product stability and development of new food products. The study of Oliveira *et al*. (OLIVEIRA *et al*., 2017) proposed the encapsulation of passion fruit seed oil using supercritical anti-solvent process and showed that the amount of oil produced reached 88% of total entrapped raw material. The results of this study showed the potential of green methods to sum value to agro-industrial waste products.

Passiflora seed oil applications: The crops of Passion fruit are examples of economically relevant species, whose fats and oils can be

used in the pharmaceutical, cosmetic, and food industries(LUCARINI *et al*., 2019). The seed oil has promising importancefor different industrial applications and sharessimilar feature to edible oils such as soybean oil (CASIERRA-POSADA e JARMA-OROZCO, 2016). This product can be used to augment the supply of vegetable oils that are very rich in bioactive compounds that can be applied in cosmetics and functional foods. Mattos *et al*. (DE PAULA *et al*., 2015) showed that the oil extracted from the passion fruit seed possesses volatile compounds that could be used as aromas of industrial interest and could result in natural essences with high addedvalue. Moreover, the oil can be a source of bio-based compounds (RODRIGUES *et al*., 2017), such as biodiesel. Other authors showed that the biodiesel blend produced from passion fruit and castor oil increased the thermal stability (Farias *et al*., 2011). KRAMBECK *et al*. (Krambeck, Karolline *et al*., 2020) compared extracts obtained by the ultrasound method in passion fruit seeds from Madeira Island and commercial oil and verified a significant content of two stilbenes in the extracts: piceatannol and resveratrol. The extracts showed antioxidant and anti-aging properties when compared to commercial oil, suggesting great potential in the pharmaceutical and cosmetic industries. In other study, Krambeck *et al*.(Krambeck, K *et al*., 2020), verified that it is possible to use passion fruit seed oil as a liquid lipid in the production of nanoparticles, with great acceptability for skin application without causing irritation. However, this study also demonstrated the instability of these nanoparticles and the need for them to be incorporated into semi-solid formulations to adjust their application. Krambeck *et al*. (Krambeck *et al*., 2021), proved the use of passion fruit seed oil with depigmenting action in the cosmetics industry. Figure 1 shows some bioactive compounds of the passion fruit seeds and some applications.

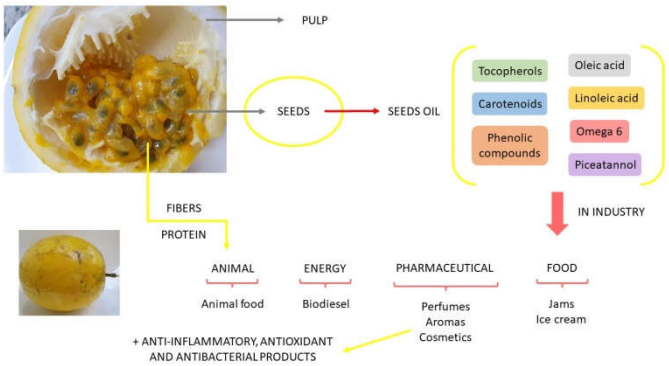


Figure 1. The passion fruit seeds, bioactive compounds and industrial uses

CONCLUSION

The oil extracted from the passion fruit seed presents several benefits and can be used in different ways, mainly because it is a residue that contains a good amount of omega 6. In the food industry, it can be used to manufacture juices and jellies. The defatted pie also has a high added value, as it is rich in proteins and fibers, thus being an excellent option for the veterinary industry to be used as an ingredient in animal feed. In the pharmaceutical area, it is attractive in the formulation of creams and shampoos. Passion fruit seed oil has valuable bioactive compounds with high concentrations of bioactive compounds with antioxidant and anti-inflammatory actions. The search for these benefits is increasing sharply in processed food and pharmaceutic compounds.

REFERENCES

Barrales, F. M. 2015. Extração de óleo de semente de maracujá (Passiflora edulis sp.) usando CO2 supercrítico assistido por ultrassom.

Barbalho, S. M. *Et al*. Effects Of Passiflora Edulis On The Metabolic Profile Of Diabetic Wistar Rat Offspring.V. 14, N. 12, P. 1490-1495, 2011. Issn 1096-620x.

Barbalho, S. M. *Et al*. Yellow Passion Fruit Rind (Passiflora Edulis): An Industrial Waste Or An Adjuvant In The Maintenance Of Glycemia And Prevention Of Dyslipidemia.V. 1, N. 1, P. 5, 2012.

Barrales, F. M. Extração De Óleo De Semente De Maracujá (Passiflora Edulis Sp.) Usando Co2 Supercrítico Assistido Por Ultrassom. 2015.

Brasil, F. I. J. N. A Microencapsulação A Serviço Da Indústria Alimentícia. 2013.

Casierra-Posada, F.; Jarma-Orozco, A. Nutritional Composition Of Passiflora Species. In: (Ed.). Nutritional Composition Of Fruit Cultivars: Elsevier, 2016. P.517-534.

Cazarin, C. B. B. *Et al*. Intestinal Anti-Inflammatory Effects Of Passiflora Edulis Peel In The Dextran Sodium Sulphate Model Of Mouse Colitis.V. 26, P. 565-576, 2016. Issn 1756-4646.

Cheok, C. Y. *Et al*. Current Trends Of Tropical Fruit Waste Utilization. Crit Rev Food Sci Nutr, V. 58, N. 3, P. 335-361, Feb 11 2018. Issn 1040-8398.

De Araújo Esteves Duarte, I. *Et al*. Brazilian Passion Fruit As A New Healthy Food: From Its Composition To Health Properties And Mechanisms Of Action. Food Funct, V. 12, N. 22, P. 11106-11120, Nov 15 2021. Issn 2042-6496.

De Paula, R. M.; Soares, A. G.; Freitas, S. P. J. C. E. T. Volatile Coumponds In Passion Fruit Seed Oil (Passiflora Setacea Brs Perola Do Cerrado And Passiflora Alata Brs Doce Mel).V. 44, P. 103-108, 2015. Issn 2283-9216.

De Souza, M. D. S. S. *Et al*. Effects Of Passiflora Edulis (Yellow Passion) On Serum Lipids And Oxidative Stress Status Of Wistar Rats.V. 15, N. 1, P. 78-82, 2012. Issn 1096-620x.

Delfini, F. D. T. Microencapsulação De Óleo Da Semente De Maracujá Através Da Secagem Por Atomização. 2016.

Dewi, N. K.; Putra, I. B.; Jusuf, N. K. J. I. J. O. D. Passion Fruit Purple Variant (Passiflora Edulis Sims Var. Edulis) Seeds Extract 10% Cream In Acne Vulgaris Treatment: An Open‐Label Pilot Study.V. 59, N. 12, P. 1506-1512, 2020. Issn 0011-9059.

Farias, R. M. *Et al*. Evaluation Of The Thermal Stability Of Biodiesel Blends Of Castor Oil And Passion Fruit.V. 106, N. 3, P. 651-655, 2011. Issn 1388-6150.

Ferrari, R. A.; Colussi, F.; Ayub, R. A. J. R. B. D. F. Caracterização De Subprodutos Da Industrialização Do Maracujá-Aproveitamento Das Sementes.V. 26, P. 101-102, 2004. Issn 0100-2945.

Garcia, J. J. C. I. D. T. D. A. Maracujá: Da Cultura Ao Processamento E Comercialização (Série Frutastropicais, 9). 1980.

He, X. *Et al*. Passiflora Edulis: An Insight Into Current Researches On Phytochemistry And Pharmacology. Front Pharmacol, V. 11, P. 617, 2020. Issn 1663-9812 (Print) 1663-9812.

He, X. *Et al*. Passiflora Edulis: An Insight Into Current Researches On Phytochemistry And Pharmacology.V. 11, P. 617, 2020. Issn 1663-9812.

Ishida, A.; Furuya, T. J. M. Diversity And Characteristics Of Culturable Endophytic Bacteria From Passiflora Edulis Seeds.V. 10, N. 4, P. E1226, 2021. Issn 2045-8827.

Krambeck, K. *Et al*. Identification And Quantification Of Stilbenes (Piceatannol And Resveratrol) In Passiflora Edulis By-Products.V. 13, N. 4, P. 73, 2020.

Krambeck, K. *Et al*. Lipid Nanocarriers Containing Passiflora Edulis Seeds Oil Intended For Skin Application.V. 193, P. 111057, 2020. Issn 0927-7765.

Krambeck, K. *Et al*. Design And Characterization Of Nanostructured Lipid Carriers (Nlc) And Nanostructured Lipid Carrier-Based Hydrogels Containing Passiflora Edulis Seeds Oil.V. 600, P. 120444, 2021. Issn 0378-5173.

Lopes, R. M. *Et al*. Estudo Comparativo Do Perfil De Ácidos Graxos Em Semente De Passifloras Nativas Do Cerrado Brasileiro.V. 32, P. 498-506, 2010. Issn 0100-2945.

Lucarini, M. *Et al*. Passion Fruit (Passiflora Spp.) Seed Oil. In: (Ed.). Fruit Oils: Chemistry And Functionality: Springer, 2019. P.577-603.

Malacrida, C. R.; Jorge, N. J. B. A. O. B.; Technology. Yellow Passion Fruit Seed Oil (Passiflora Edulis F. Flavicarpa): Physical And Chemical Characteristics.V. 55, N. 1, P. 127-134, 2012. Issn 1516-8913.

Maruki-Uchida, H. *Et al*. Effect Of Passion Fruit Seed Extract Rich In Piceatannol On The Skin Of Women: A Randomized, Placebo-Controlled, Double-Blind Trial.V. 64, N. 1, P. 75-80, 2018. Issn 0301-4800.

Matsumoto, Y.; Katano, Y. Cardiovascular Protective Effects Of Polyphenols Contained In Passion Fruit Seeds Namely Piceatannol And Scirpusin B: A Review. Tokai J Exp Clin Med, V. 46, N. 3, P. 151-161, Sep 20 2021. Issn 0385-0005.

Oliveira, D. *Et al*. Encapsulation Of Passion Fruit Seed Oil By Means Of Supercritical Antisolvent Process.V. 129, P. 96-105, 2017. Issn 0896-8446.

Piombo, G. *Et al*. Characterization Of The Seed Oils From Kiwi (Actinidia Chinensis), Passion Fruit (Passiflora Edulis) And Guava (Psidium Guajava).V. 13, N. 2-3, P. 195-199, 2006. Issn 1258-8210.

Regis, S. A.; Resende, E. D. D.; Antoniassi, R. J. C. R. Qualidade Do Óleo Das Sementes Do Maracujá Submetidas Ao Processo De Purificação Dos Resíduos Da Polpa.V. 45, P. 977-984, 2015. Issn 0103-8478.

Rodrigues, J. D. *Et al*. Bio-Based Polyurethanes And Composites From Passion Fruit Oil Methyl Esters And Coconut Husk Fibers. In: (Ed.). Biocomposites: Properties, Performance, And Applications: Nova Publishers Hauppauge, Ny, Usa, 2017. P.125-143.

Silva, M. F. *Et al*. Volatile Emissions Of Watercress (Nasturtium Officinale) Leaves And Passion Fruit (Passiflora Edulis) Seeds Against Meloidogyne Incognita.V. 76, N. 4, P. 1413-1421, 2020. Issn 1526-498x.

Silva, R. *Et al*. Chemical Characterization Of Passion Fruit (Passiflora Edulis F. Flavicarpa) Seeds.V. 14, N. 14, P. 1230-1233, 2015. Issn 1684-5315.

Vieira, M. A. R. Caracterização Dos Ácidos Graxos Das Sementes E Compostos Voláteis Dos Frutos De Espécies Do Gênero Passiflora. 2006.

Zeraik, M. L. *Et al*. Passion Fruit: A Functional Food? , V. 20, N. 3, P. 459-471, 2010. Issn 0102-695x.

****