Int.J.Curr.Res.Aca.Rev.2020; 8(6): 1-5

EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 (Online) Volume 8 Number 6 (June-2020)

Journal homepage: http://www.ijcrar.com

doi: https://doi.org/10.20546/ijcrar.2020.806.001

Beetroot Tremendous Health Benefits and Recent Trends of Utilization: A Review

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Abstract

Beetroot (*Beta vulgaris*) belongs to the family chenopodiaceae. Beetroot is known for the colouring pigments betalains comprising of betacyanin and betaxanthin responsible for purple and yellow colour respectively. The beetroot exhibited excellent functional benefits and its extract have nutraceuticals potential. Recent investigations have enlarged the application of beetroot by making powder by drying process. The dried beetroot had led to nutritional enrichment in food products in mayonnaise and bakery products as well as used for edible packaging. Therefore the present study highlights various aspects regarding beetroot including health benefits, bioactive components, utilization in food products and recent trend.

Article Info

Accepted: 04 May 2020
Available Online: 20 June 2020

Keywords

Betalins, Phenolic, Anti-Oxidant, Colorant, Health.

Introduction

Plant foods are crucial to human endurance due to its inherited nutritional significance. Beetroot (*Beta vulgaris*) represented as blessings of nature to human health since the earliest times. *Beta vulgaris* belongs to the family chenopodiaceae. It originated in 8th century from Mesopotamia civilization and from then it had been grown for its medicinal purposes. Among various varieties of the beetroot the yellow beet variety had its origin in 1700s. There was substantial evidence of production of sugar beets in the earlier time of Prussians in the 1800s. Now, red beets are more commonly harvested in Europe, America and throughout Asia (Chawla *et al.*, 2016). France, Russia, Germany, USA, Turkey are the major contributor countries to beetroot production on world level.

Beetroot contains significant level of antioxidants as well as many other health promoting compounds including vitamins and minerals such as potassium, magnesium, folic acid, iron, zinc, calcium, phosphorus, sodium, niacin, biotin, pyridoxine and soluble fibre. The colouring pigments found in beetroot is known as betalains consisting of components betacyanin and betaxanthin that convey purple and yellow colour respectively. These betalains have the antioxidant potential in beetroot (Escribano *et al.*, 1998, Fatma *et al.*, 2016).

Due to the perishable characteristics of beetroot drying method can be adopted as a preservation method. The use of red beetroot improves cardiovascular health, lowers blood pressure (Jajja *et al.*, 2014) and enhances performance during running exercises (Murphy *et al.*, 2012). Red beetroot powder is used as natural colorant in food products as well as instant beverages for athletes (Ng and Sulaiman, 2018). Encapsulation is also used now days to preserve several bioactive compounds to improve stability and bioavailability (Aguirre Calvo and

Santagapita, 2016). The incorporation of red beet bioactive into food products provides many advantages in food preservation and contributes functional foods behavior in food by the application of emerging technologies (Galanakis, 2013).

Varieties of beetroot

Beetroot varieties include, Detroit Dark Red, Crimson Globe, Crosby Egyptian and Early Wonder. Detroit Dark Red beetroot has soft roots, consistent, with dark red flesh. Crimson Globe beetroots have little shoulders; flesh is medium dark red. Crosby Egyptian beetroot is a flat globe and internal color is dark purplish red. Wonder root is flat and the central flesh is dark red (Chawla *et al.,* 2016).

Cultivation of beetroot

The ideal pH for beetroot production lies between 6.0-8.0. Beetroot prefer deep, friable, well drained, sandy loams to silt loams. The row spacing is between 5 and 10cm that depend on the size required at harvest time. The water content of 300-350 mm is required throughout the growing cycle that includes on an average of 4mm per day.

Bioactive compounds in beetroot

Beetroot contains highly active pigments, betalains, ascorbic acid, carotenoids, polyphenols, flavonoids, saponins and high levels of nitrate. Glycine, betaine and folate are the bioactive compounds that found in low levels. *Phenolic compounds* Phenolic compounds are a huge group of plant metabolites and significant for excellence of plant based foods. Beetroot has high amount of phenolic compounds and flavonoids (Kathiravan *et al.,* 2014). These phenolic acids include epicatechin, catechin, rutin, vanillic, *p*-coumaric, protocatechuic, caffeic acid, syringic acids and proline (Maraie *et al.,* 2014) (Table 1).

Health benefits of beetroot

Beetroot contains bunch of bioactive compounds accounted for natural antianemic, antiinflammatory, anti-hypertensive, antioxidant, anticarcinogenic, antipyretic, antibacterial, detoxicant and diuretic properties (Lidder and Webb, 2013). Betalains the main bioactive component found in beetroot had reported for therapeutic, anticarcinogenic, hepato-protective and antitumor properties (Wootton-Beard *et al.,* 2011). The beetroot contain flavonoids such as vitexin, vitexin-2-O-rhamnosideand vitexin-2-O-xyloside explained outstanding antiproliferative activity on cancer cell lines (Slavov *et al.,* 2013). The nitrates found in beetroot have potential to decrease the blood pressure and improve working of the mitochondria in body (Satyanand *et al.,* 2014). It reduces the bad cholesterol, oxidized LDL cholesterol and normalizes the blood pressure (Guldiken *et al.,* 2016).

Utilization of red beet

Red beet powder

The microwave and ohmic heating at 525 or 420 W and 17.5 V/cm respectively compared for nutritional properties and beetroot powder prepared from microwave treatment were found more suitable to phenolic content, antioxidant activity, betalains content and color characteristics.

Table.1 Bioactive compounds present in beetroot

Class of compounds		**references**
Phenolic compound (**peel of the beetroot**)	vulgaxanthin I, vulgaxanthin II, indicaxanthin, prebetanin, isobetanin, betanin and neobetanin	Nemzer *et al.,* 2011
Phenolic compound (from seed of beetroot)	*N-trans*-feruloyltyramine and *N-trans* feruloylhomovanillylamine	Nemzer *et al.,* 2011
flavanones	betagarin and betavulgarin	Lim, (2016)
phytochemical	Poly 3-hydroxyalkanoate	Lim, (2016)
Betalains	betacyanin (red pigment) and betaxanthin (yellow pigment)	Szopinska and Gawęda, 2013
carotenoids	lutein	Rebecca *et al.,* (2014)

Table.2 Extraction of beetroot bioactive by various methods

Bioactive component	Extraction methods	Optimized conditions	References
Betanine	Pulse electric field	5 pulses of 2 ls at 7 kV/cm, 90% of total betanine in 300 min	López *et al.*, (2009)
Antioxidant	supercritical CO_2 extraction	35 °C/400 bar, total phenolics 3370.8 g GAE/ g dry matter basis, and DPPH antioxidant activity 1454.0 g TE/g	Goyeneche *et al.*, (2020)
betanin/isobetanin	Solid phase extraction	promising method for beetroot extract	Nestora *et al.*, (2016)
Ca, K, Mg and Na	solid phase extraction	dilution of samples with 0.5 mol L^{-1}	Pohl *et al.*, (2019)
Dye	Ultrasound	1:1 (ethanol: water), 80 W ultrasonic power for 3 h	Sivakumar *et al.*, (2009)

Raikos *et al.*, (2016) studied processing of beetroot at Microwave power (960 watt for 7 min) was suitable for protecting the betalain and polyphenolic content of beetroot when compared with heat treatment as roasting (180 °C for 90 min) and boiling (100 °C for 30 min). The microwave treated beetroot significantly enhanced the oxidative stability of mayonnaise stored at 4 ºC for 4 weeks.

Beetroot juice

Recent studies conducted on beetroot juice have established the benefits of it in healthy body by rising exercise tolerance, reducing the O_2-rate during exercise, and/or reducing blood pressure (Cuenca *et al.*, 2018). Kroll *et al.*, (2018) revealed that use of beetroot juice extremely increase levels of FE_{NO} in healthy students to cure cold symptoms severity, and feeling sick.

Beetroot candy

Fatma *et al.*, (2016) prepared nutritious, wholesome and delicious beetroot candy, using ingredients like sugar, pectin and citric acid in different ratios. The beetroot candy is an alternative those who avoid fresh beetroot due to unpleasant taste.

Recent research on beetroot bioactive

Cejudo-Bastante *et al.*, (2019) developed the bioactive packaging with ethylene vinyl alcohol (EVOH) copolymer possessing betalain rich red beet. The addition of the beet extract (0.1, 0.5, 1.0, 1.5, 2.0 and 2.5 % (w/w)) led to a film with higher color intensity, antioxidative activity and water loss rate in lesser quantity. Sucheta *et al.*, (2019) developed the composite edible films using beetroot powder and structural, mechanical and functional characterization was evaluated for suitability in edible packaging (Beetroot juices have shown as a great source of selenium compounds. Sentkowska *et al.*, (2020) estimated the concentrations of selenomethionine and methylselenocysteine using hydrophilic interaction liquid chromatography (HILIC) chromatography. The yellow pigment content in beetroot had found to be due to mainly the occurrence of selenocysteine.

The microencapsulation properties and stability of spray-dried beetroot extract using maltodextrin (MD), inulin (IN), and whey protein isolate (WPI) were evaluated (Carmo *et al.*, 2017). The parameter as moisture, betalains content and its retention in the encapsulated matrix were measured as 3.33–4.24%, 348.79–385.47 mg/100 g (dry-basis), and 88.45–95.69%, respectively. The Higher values of antioxidant were observed for the carrier agent WPI. Kohajdová1 *et al.*, (2020) reported that the beetroot powder have been found in bakery food preparation by increasing the water absorption in dough, dough development delaying time, and good dough stability but the mixing tolerance index decreased.

Conclusion and Future trend

Beetroot in fresh as well as in form of juice, powder is source of precious vital nutrients and its ample amount of advantageous bioactive compounds accounted for health promotion and disease prevention. Beetroot color and essential components can be preserved by either drying or microencapsulation techniques. In the present time of innovation demanded in the area of nutrition and food beetroot have tremendous potential for its suitability in various food products.

References

Aguirre Calvo, T.R., Santagapita, P.R., (2016). Physicochemical characterization of alginate beads containing sugars and biopolymers. *Journal of Quality Reliability Engineering*, 9184039.

Carmo, E.L.D., Teodoro, R.A.R., Campelo Félix, P.H., Barros Fernandes, R.V.D., Oliveira, E.R.D., Abreu Veiga, T.R.L., Borges, S.V., Botrel, D.A. (2017), Stability of spray-dried beetroot extract using oligosaccharides and whey proteins, *Food Chemistry*, https://doi.org/10.1016/j.2017.12.076

Cejudo-Bastante, M.J., Cejudo-Bastante, C., Cran, M.J., Francisco J. Herediaa, Stephen W. Bigger (2020). Optical, structural, mechanical and thermal characterization of antioxidant ethylene vinyl alcohol copolymer films containing betalain-rich beetroot, *Food Packaging and Shelf Life*, 24:100502

Chawla, H., Parle, M., Sharma, K., and Yadav, M. (2016). Beetroot: A Health Promoting Functional Food. *Nutraceuticals, 1*, 0976-3872.

Cuenca, E., Jodra, P., Pérez-López, A., González-Rodríguez, L.G., Fernandes da Silva, S., Veiga-Herreros, P., Domínguez, R. (2018). Effects of beetroot juice supplementation on performance and fatigue in a 30-s all-out sprint exercise: a randomized, doubleblind cross-over study, *Nutrients*, https://doi.org/10.3390/nu10091222 (pii: E1222).

Escribano, J., Pedreno, M. A., Garcia-Carmona, F., and Munoz R. (1998). Characterization of the antiradical activity of betalains from beta vulgaris L. roots, *Phytochem Analysis*, 9: 124-127

Fatma, S., Sharma, N., Singh, S.P., Jha, A., and Kumar, A. (2016). Fuzzy Analysis of Sensory Data for Ranking of Beetroot Candy, *International Journal of Food Engineering*, 2(1): 26-30.

Galanakis, C.M., (2013). Emerging technologies for the production of nutraceuticals from agricultural by-products: a viewpoint of opportunities and challenges. *Food Bioproduct Processing*, 91: 575-579.

Goyeneche, R., Scala, K.D., Ramirez, C.L., and Fanovich, M.A (2020). Recovery of bioactive compounds from beetroot leaves by supercritical CO_2 extraction as a promising bioresource, *Journal of Supercritical Fluids*, 155, 104-658.

Guldiken, B., Toydemir, G., Nur Memis, K., Okur, S., Boyacioglu, D., and Capanoglu, E. (2016). Home-processed red beetroot (*Beta vulgaris* L.) Products: Changes in antioxidant properties and bioaccessibility. *International Journal of Molecular Sciences, 17*, 858.

Jajja, A., Sutyarjoko, A., Lara, J., Rennie, K., Brandt, K., Qadir, O., Siervo, M. (2014). Beetroot supplementation lowers daily systolic blood pressure in older, overweight subjects. *Nutrition Research*, 34, 868-875. https://doi.org/10.1016/j.nutres.2014.09.007

Kathiravan, T., Nadanasabapathi, S., and Kumar, R. (2014). Standardization of process condition in batch thermal pasteurization and its effect on antioxidant, pigment and microbial inactivation of Ready to Drink (RTD) beetroot (Beta vulgaris L.) juice. *International Food Research Journal, 21*(4), 1305.

Kohajdová1, Z., Karovičová1, J., Kuchtová1, V., Lauková, M (2018). Utilisation of beetroot powder for bakery applications, chemical papers, https://doi.org/10.1007/s11696-018-0392-z

Kroll, J.L., Werchan, C.A., Rosenfield, D., and Ritz, T. (2018). Acute ingestion of beetroot juice supplement increases levels of exhaled nitric oxide in healthy individuals, PLoS One 13 (2018) e0191030, https://doi.org/10.1371/journal.pone.0191030.

Lidder, S., and Webb, A. J. (2013). Vascular effects of dietary nitrate (as found in green leafy vegetables and beetroot) via the nitrate-nitrite-nitric oxide pathway. *British Journal of Clinical Pharmacology, 75*, 677–696.

Lim, T. K. (2016). Beta vulgaris. *In Edible Medicinal and Non-Medicinal Plants pp.* 26-68.

López, N., Puértolas, E., Condón, S., Raso, and Alvarez, I. (2009) Enhancement of the extraction of betanine from red beetroot by pulsed electric fields, *Journal of Food Engineering*, 90 60–66

Maraie, N. K., Abdul-Jalil, T. Z., Alhamdany, A. T., and Janabi, H. A. (2014). Phytochemical study of the Iraqi Beta vulgaris leaves and its clinical application for the treatment of different dermotological

diseases. *World Journal of Pharmacy and Pharmaceutical Sciences*, 3, 05-19.

Murphy, M., Eliot, K., Heuertz, R.M., Weiss, E. (2012). Whole Beetroot Consumption Acutely Improves Running Performance. *Journal of the Academy of Nutrition and Dietetics*, 112(4), 548-552. https://doi.org/10.1016/j.jand.2011.12.002

Nemzer, B., Pietrzkowski, Z., Spórna, A., Stalica, P., Thresher, W., Michałowski, T., and Wybraniec, S. (2011). Betalainic and nutritional profiles of pigment-enriched red beet root (*Beta vulgaris* L.) dried extracts. *Food Chemistry*, *127*, 42-53.

Nestora, S., Merlier, F., Prost, E., Haupt, K., Rossi, C., and Bui, B.T.S (2016) Solid-phase extraction of betanin and isobetanin from beetroot extracts using a dipicolinic acid molecularly imprinted polymer, http://dx.doi.org/10.1016/j.chroma.2016.08.069

Ng, M.L., Sulaiman, R. (2018). Development of beetroot (Beta vulgaris) powder using foam mat drying. *LWT - Food Science and Technology*, 88, 80-86. https://doi.org/10.1016/j.lwt.2017.08.032

Pohl, P., Kalinka, M., and Pieprz, M. (2019). Development of a very simple and fast analytical methodology for FAAS/ FAES measurements of Ca, K, Mg and Na in red beetroot juices along with chemical fractionation of Ca and Mg by solid phase extraction, *Microchemical Journal*, 147 538–544

Raikos, V., McDonagh, A., Ranawana, V., Duthie, G. (2016). Processed beetroot (*Beta vulgaris* L.) as a natural antioxidant in mayonnaise: Effects on physical stability, texture and sensory attributes, http://dx.doi.org/doi:10.1016/j.fshw.2016.10.002

Rebecca, J., Sharmila, S., Das, M. P., and Seshiah, C. (2014). Extraction and purification of carotenoids from vegetables. *Journal of Chemical and Pharmaceutical Research*, 6, 594- 598.

Satyanand, V., Vali, S. M., and Krishna, B. P. (2014). A study of beet root derived dietary nitrate efficacy on performance of runners. *Indian Journal of Basic and Applied Medical Research*, 3, 690-695.

Sentkowska, A., and Pyrzynska, K. (2020). Determination of selenium species in beetroot juices Heliyon, 6: e04194

Sivakumar, V.S. Anna, J.L., Vijayeeswarri, J., and Swaminathan, G. (2009). Ultrasound assisted enhancement in natural dye extraction from beetroot for industrial applications and natural dyeing of leather, *Ultrasonics Sonochemistry*, 16:782–789

Slavov, A., Karagyozov, V., Denev, P., Kratchanova M., and Kratchanov, C. (2013). Antioxidant Activity of Red Beet Juices Obtained after Microwave and Thermal Pretreatments. *Czech Journal of Food Sciences*, *31*, 139–147.

Sucheta, Rai, S.K., Chaturvedi, K., Yadav, S.K (2019). Evaluation of structural integrity and functionality of commercial pectin based edible fims incorporated with corn flur, beetroot, orange peel, muesli and rice flour, *Food Hydrocolloids*, 9:127–135.

Szopinska, A. A., and Gawęda, M. (2013). Comparison of yield and quality of red beet roots cultivated using conventional, integrated and organic method. *Journal of Horticultural Research*, *21*, 107-114.

Wootton-Beard, P. C., Moran, A., and Ryan, L. (2011). Stability of the antioxidant capacity and total polyphenol content of commercially available vegetable juices before and after in vitro digestion as measured by FRAP, DPPH, ABTS and Folin Ciocalteu methods. *Food Research International*, *44*, 217–224.

How to cite this article:

Mansoor Ali Akhone, Shantanu Rana and Rajeev Kumar. 2020. Beetroot Tremendous Health Benefits and Recent Trends of Utilization: A Review. *Int.J.Curr.Res.Aca.Rev.* 8(6), 1-5.
doi: https://doi.org/10.20546/ijcrar.2020.806.001