IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Health Benefits And Antioxidant Properties Of Basil(*Ocimum basilicum)*

Sanket R.Bavche*,Maya J.Dane*,Dr.Rajendra Kawade, Prof. Gayatri v.Dusane,

Sanket D.Thore.

Nandkumar Shinde College of Pharmacy,Aghur,Tq.Vaijapur,Dist.Chh.Sambhajinagar.

Corresponding author : Sanket R.Bavche*

Nandkumar Shinde college of pharmacy,Vaijapur,

Dist.Chh.Sambhajinagar

Abstract:

One of the most significant crops is basil (Ocimum basilicum), which also contains polyphenols, phenolics, flavonoids, and phenolic acids in addition to essential oils. This annual plant is native to tropical areas and is a member of the mint family. In addition to its many medicinal uses, basil leaves are frequently added to rice, pork, stews, and soups. It has historically been used to treat renal issues, earaches, irregular menstruation, arthritis, anorexia, colds, malaria, and as a hemotypic during childbirth. It has been demonstrated that basil helps fight off bacterial, fungal, viral, and other infections. Asthma, bronchitis, influenza, fevers, coughing, and diarrhea have all been treated using basil leaves. Basil seed gum is another name for basil seed mucilage. Mucilage from basil seeds is a hydrocolloid that thickens, stabilizes, replaces fat, texurizes, is surface-active, and emulsifies. The most significant pharmacological applications of basil include its anti-cancer, anti-microbial, anti-inflammatory, immunomodulatory, anti-stress, anti-diabetic, anti-pyretic, anti-arthritic, and anti-oxidant properties, as well as its use as a preventative measure and in the treatment of cardiovascular disease. Sweet basil, often known as Genovese basil, is a common culinary spice used in Mediterranean and Italian cuisine. Iron, calcium, vitamin K, vitamin A, and vitamin C are among the minerals and vitamins it contains. Many food and beverage sectors use the aromatic sweet basil leaf directly as a flavoring ingredient. It is also widely used in the cosmetics, fragrance, and pharmaceutical industries.

Keyword: Basil; health benefits, chemical composition, antioxidant property

Introduction:

Ocimum contains about 30 different types of shrubs and herbs. Its morphology, flower color, growth patterns, chemical makeup, leaves, and stems were all highly variable. Asia, central and southern America, and Africa are the genus's natural regions. It was referred to be the herb of kings by the ancient Greeks. Ocimum basilicum L. is known in English as basil, but in French, German, and Spanish it is named basilic, basilikum, and albahaca, respectively. In Arabic and Persian, it is also known as rehan and reihan, respectively. Ocimum americannum L., Ocimum basilicum L., Ocimum hispidulum Schum, Ocimum tenuiflorum L., Ocimum sanctum L., and Ocimum ratissimum L. are the most significant members of the Ocimum genus. While O. americanum is commonly known as hoary basil, hairy basil, American basil, lemon basil, and spice basil, Octimum basilicum is commonly known as sweet basil. O. gratissimum is commonly known as African basil, tree basil, and shrubby basil, whereas O. campechianum is commonly known as least basil, Peruvian basil, and spice basil. O. xcitriodorum and O. kilimandscharicum are commonly referred to as lemon basil and camphor basil, respectively. Linalool, methyl chavicol, eugenol, bergamotene, and methyl cinnamonate are the main volatile ingredients of basil. Additionally, basil is linked to Chinese, Indian, Italian, and Iranian cuisines. The amounts of essential oils and other chemical components differ among species and cultivars. and various circumstances for growth. The biochemical components of medicinal plants can be influenced by a number of factors, including genotype, cropping seasons, and geographic characteristics.This mini-review article's goal was to provide an overview of the key chemical components and pharmacological advantages of basil in both conventional and modern research.

Figure: Basil Plant

Taxonomical Classification:

Kingdom: Plantae

Order: Lamiales

Family: Lamiaceae

Genus: Ocimum

Species: Ocimum basilicum

Biological name: Ocimum basilicum

Health benefits of basil herb:

Despite having a high concentration of powerful compounds and active ingredients that can have an impact on human health, basil seeds are usually disregarded. Dietary fiber, vitamin A, iron, protein, polyphenols, and a few other active components are all found in basil seeds. The health effects of basil seeds can be either positive or negative. The capacity of basil seeds to enhance digestive wellness, aid in weight loss, enhance skin appearance, fortify hair, control blood sugar, cool the body, reduce tension, and strengthen bones is among their most noteworthy health advantages. The inclusion of hemicellulose and cellulose in basil seeds also helps to improve vision, decrease blood pressure, and lessen their hydrophilic character.

Skin care:

The flavonoids and antioxidants in basil seeds may help promote the formation of new skin cells and enhance skin health. Applying crushed basi seeds with coconut oil to the affected areas can help treat a variety of skin disorders, including dermatitis and psoriasis. Regular consumption of basil seeds promotes the release of collagen, which is essential for the creation of new skin cells in the case that daily wear and tear damages existing ones. As a result, it is a powerful anti-aging diet that also promotes skin suppleness. In a second single-blind research with 11 male volunteers, The base formulation without basil was contrasted with a face skin cream formulation that contained a 3% concentrated ethanol extract of basil leaves and flowers. The respondents spent a considerable amount of time at night applying the two lotions to their isolated cheeks. The degree of skin smoothness, moisture content, and wrinkle prevalence were determined using biophysical measures. When compared to the base cream, the definition with basil basically increased the amount of moisture, decreased roughness, and buried wrinkles. There were no negative effects observed. In a single-blind controlled research, 25 dermatological outpatients in India were assigned to the treatment group and 26 were randomly assigned to the control group. As a typical acne treatment, 500 mg of oral tetracycline was given to the control group. Before washing their faces with mild soap the following morning, the treatment group was told to manually crush fresh O basilicum leaves, apply the juice to their facial acne lesions, and leave the covering on overnight. They were also given face sulfur lotion twice a day. These therapies were administered to each group for a further eight weeks Comedones, papules, pustules, and cysts were among the acne lesions that responded well to the basil treatment, indicating that it was equally effective as the conventional acne medicine. A randomized, fictitious treatment controlled clinical trial was conducted on a series of 16 O gratissimum-containing plans (n = 7 for each definition) for the treatment of skin inflammation vulgaris among college students in Nigeria. Fifteen test samples were made using one of four base blends and one of four dosages of O gratissimum essential oil.

They were administered topically to the face twice a day for four weeks. The rejuvenating ointment regimens, particularly at higher dosages, were essentially more effective than a reference medication (10% benzoyl peroxide moisturizer) at reducing the number of papules and pustules compared to the sore counts before the evaluation at around one month. There were no known adverse effects, despite the fact that some larger dosages caused skin irritation. Using blessed basil has amazing benefits for good skin. Basil is commonly used in skin care products for both adults and newborns. One such cream that is made completely of herbs, such as aloe vera, neem, and basil, is Rustic Art Neem and Basil. In my neighborhood, many mothers use it to treat their children's rashes. It heals rashes and soothes the skin. In one review, one group of participants received a face cream that contained several ingredients in addition to 3% ethanolic basil separate, while the other group received a similar cream that did not contain any basil. The formulation that included holy basil was less harsh, wrinkled less, and had a significantly higher moisture content.

Hair care:

Basil seeds can promote hair growth and prevent premature hair loss because of their high iron and antioxidant content. Additionally, oxidative stress and inflammation on the scalp, which often lead to hair loss, are avoided. Due to their high protein and vitamin K content, these seeds can help you grow gorgeous, healthy hair. Dandruff is reduced by holy basil. Hair loss may also be cured by it.

- Low cholesterol: They help reduce bad cholesterol levels, which reduces the risk of plaque accumulation and atherosclerosis in the arteries and blood vessels. This will also reduce cardiac strain and the chance of heart attack and stroke. Seven clinical studies have reported the beneficial effects of holy basil on human lipid profiles. The tests used the following dosages for eight to twelve weeks. Himalaya Pharmaceuticals in India supplied 250 mg tulasi leaf capsules, which were taken twice a day before meals for eight weeks. A 5 ml aqueous holy basil leaf was given twice a day before meals for 8 and 12 weeks. For 12 weeks, take 3 grams of whole plant powder daily. Saabia seeds are said to have a lot of alpha-linolenic acid (ALA), which is produced by the seeds' high amount of Omega 3 fatty acids.
- Cardiovascular health: Research has indicated that sweet basil may be beneficial for cardiovascular health. Sweet basil, for instance, may help lower blood pressure and enhance blood lipid levels, which may help lessen the risk of heart disease, according to some research. The effects of this plant on prostaglandins to lower blood pressure and stop thrombosis were studied. OBL and its extracts reduced the production of PGE2 and TXB2 and increased 6-keto-PGF1 in a dose- and time-dependent manner. This could indicate that endothelial COX-1 is increased and COX-2 is suppressed at the same time. The butanol fraction seemed to be the most promising in this respect

Blood pressure:

There is enough potassium in these seeds to directly affect blood pressure. Due to its vasodilator properties, potassium can relax blood vessels and arteries, reducing cardiovascular system stress and having a hypotensive effect. The possible antihypertensive effects of OBL extract were examined in renovascular hypertensive rats. Since OBL's effects on blood pressure, cardiac hypertrophy, and ET are consistent with an action on the ET-converting enzyme, more research is required. The potential of holy basil to lower blood pressure has only been shown in three published research to date. For 12 to 4 weeks, fresh holy basil leaf juice was used in each of the three studies. The juice, which comprised 75% basil, was made from 15 fresh leaves of the holy basil plant. It was consumed twice daily before meals. The blood pressure significantly decreased in each of the three studies.

Boost bone health:

Among the numerous minerals present in basil seeds that enhance bone mineral density are iron, potassium, copper, calcium, magnesium, and manganese. This will lower your risk of developing osteoporosis and keep you feeling robust and young. A study found that gouty arthritis can be relieved and uric acid levels lowered by taking 10 drops of holy basil tincture three times a day for 12 weeks.

Control blood sugar level :

Dietary fibers found in basil seeds have the ability to regulate blood sugar levels. Since they are known to control blood sugar levels, they are regarded as beneficial for those with type II diabetes. They regulate how carbs are converted to glucose by slowing down the body's metabolism. Throughout the day, a glass of water with basil seeds in the morning can increase insulin sensitivity the entire day.

- Enhance dental and ocular health: Due to its high vitamin A content, basil seeds are recommended for people with deteriorating vision or high oxidative stress levels. Vitamin A is a strong antioxidant that

slows the development of cataracts and postpones the onset of macular degeneration in the retina. Basil seeds help to prevent cavities, plaque, foul breath, and mouth ulcers because of their antifungal, antibacterial, antiviral, and antimicrobial qualities. Chew on some basil seeds to help your breath feel fresher.

- Reduce pain: Studies have shown that basil seeds can reduce the intensity of flare-ups in conditions like gout, arthritis, headaches, and irritable bowel syndrome. Basil seeds' anti-inflammatory properties aid in lowering inflammation, discomfort, and swelling. In Ayurveda, it has been used for generations to stop the accumulation of blood vessel plaque. A paste produced from holy basil seeds can be used to treat scorpion stings and spider bites. Using holy basil paste prepared from the leaves or roots has also been recommended by other studies

Reduce body heat:

In several Asian countries, drinks are made with basil seeds, water, sugar, honey, and other components. During the intense heat, it's a great beverage for cooling off. Using basil seeds is one of the best ways to cool the body. They are known to reduce body temperature. Basil seeds are added to the drinks to increase their cooling properties.

Cough and flue:

Because of their antispasmodic qualities, basil seeds help to relax and relieve tension in the spasmatic muscles. They aid in the management of whooping cough in this way. They boost the body's defenses against illness. The body's defenses are strengthened by flavonoids such as beta carotene, orietin, and vicenin .A common component of many Ayurvedic cough syrups and expectorants is basil. A fast-acting influenza treatment is made using holy basil leaves, cloves, and table salt. Eat the leaves for relief from the cold. Drinking water that has been boiled with holy basil leaves can help relieve a sore throat.

Respiratory health:

Studies have indicated that sweet basil may have potential advantages in supporting respiratory health, which is how it has been utilized traditionally. Sweet basil, for instance, has been demonstrated to have bronchodilator properties, which may lessen the symptoms of asthma and other respiratory disorders. Three daily dosages of 500 mg of dried holy basil leaves were found to alleviate asthma symptoms in three days in a study including asthma patients. It helps to mobilize mucus produced by bronchitis and asthma, which is beneficial for the respiratory system's healthy functioning.

Digestive health:

Traditionally, sweet basil has been used to promote digestive health, and some research indicates that it might also help with this. Sweet basil, for instance, may help lessen the symptoms of irritable bowel syndrome (IBS) and has been demonstrated to have anti-ulcer qualities.. It is commonly known that basil seeds aid in the body's natural detoxification process by cleansing the stomach and assisting in the elimination of toxins from it. They have volatile oils that help the gastrointestinal tract expel gas and facilitate digestion. It also provides calming and soothing effects on the stomach

Nutritional composition:

- Calories: 23
- Carbohydrates: 2.7 g
- Protein: 3.2 g
- Fat: 0.6 g
- Fiber: 1.6 g

- Vitamin K: 414% of the Daily Value (DV)
- Vitamin A: 175% of the DV
- Vitamin C: 30% of the DV
- Calcium: 18% of the DV
- Iron: 21% of the DV

Antioxidant property:

Plants create phytochemicals to defend themselves against pathogens and environmental stress. Diabetes and cancer can be prevented with the use of phytochemicals. Plant cells are maintained by primary metabolites, whereas normal plant growth, development, and defense are mediated by secondary metabolites. The majority of these substances are either nitrogen-deficient terpenoids and phenolics or nitrogen-containing alkaloids. The acetate and shikimate routes (from phenylalanine or tyrosine) are the biosynthesis sources of flavonoids and phenolic acids. Ocimum basilicum L. has been shown to contain a variety of chemicals, including flavonoids, alkaloids, phenol, and essential oils. Of these, flavonoids have the most potential as antioxidants.Protein content in Ocimum basilicum is substantial and consistent with previous findings. Plant antioxidants give their bioactive components the ability to scavenge free radicals and help us understand how their phytoconstituents work. O. basilicum leaves scavenge DPPH and ABTS radicals.

In the current investigation in a concentration-dependent way. DPPH is a purple stable free radical that can react with plants' bioactive chemicals (free radical quenchers) to form the colorless α-α-diphenyl-β-picryl hydrazine. A drop in absorbance at 517 nm can be used to determine the quantity of DPPH that is lowered. Because of the radical scavenging properties of the antioxidants found in plants, the ABTS assay reduces the color intensity of an ethanolic solution containing pre-formed radical monocation of ABTS, which is produced by oxidizing ABTS with potassium persulfate . The antioxidant effectiveness of the chemical in the plant extract is directly correlated with the color change's intensity. At 1000 µg/ml, an extract from O. basilicum leaves efficiently scavenged 84% of DPPH radicals (IC50=586.3 µg/ml) and 79% of ABTS radicals (IC50=727.9 µg/ml). The NBT photoreduction method was used to measure the superoxide radicals produced in vitro by the device. The consumption of superoxide anion in the reaction mixture is indicated by the decrease in absorbance at 560 nm with the plant extract. SOD transforms superoxide radicals into hydrogen peroxide, which in turn generates reactive hydroxyl radicals. A maximum of 81% superoxide scavenging activity was demonstrated by the extract of O. basilicum leaves (IC50= 604.2 µg/ml). Oxygen nitrate It is crucial for both the production of severe oxidative stress and the activation of N-methyl-D-aspartate (NMDA) receptors. Lipid peroxidation and neuronal cell death due to DNA damage are caused by NO-induced oxidative stress. Nitric oxide scavenging activity in the current investigation was 83%, with an IC50 value of 652.60 µg/ml.

Conclusion:

The Lamiaceae plant Ocimum basilicum is found in Africa, tropical Asia, South America, and Focal America. It has a very remarkable sweet and spicy scent and is frequently grown as a fixer or to produce therapeutic oil. In addition to its use as a condiment, this herb has been associated with important health advantages. It is used in traditional medicine to treat intestinal infections, menstruation cramps, vomiting, diarrhea, and renal problems. Some studies have shown that it can treat hyperlipidemia and has anti-inflammatory, antioxidant, vasodilator, neuroprotective, and hepatoprotective qualities. The health effects of basil seeds can be either positive or negative. Basil seeds' capacity to enhance digestive wellness, aid in weight loss, enhance skin appearance, fortify hair, control blood sugar, chill the body, reduce tension, and strengthen bones is among their most noteworthy health advantages. The hemicellulose and cellulose found in basil seeds also contribute to their capacity to reduce blood pressure, enhance vision, and minimize their

hydrophilic character. They have a high fiber content, lower cholesterol, lessen inflammation, and avoid several connected nutritional problems. Sweet basil, sometimes referred to as Genovese basil, is a popular culinary plant that is widely used in Mediterranean and Italian cooking. Among the minerals and vitamins it contains are calcium, iron, vitamin K, vitamin A, and vitamin C. The aromatic leaf of sweet basil is used directly as a flavoring ingredient in a number of food and beverage industries. It is also widely used in the pharmaceutical, cosmetic, and aromatherapy sectors.

Reference:

[1] Jirovetz, L.; Buchbauer, G.; Shafi, M. P.; Kaniampady, M. M. Chemotaxonomical Analysis of the Essential Oil

Aroma Compounds for Four Different Ocimum Species from Southern India. Eur. Food Res. Technol. 2003, 217,

120–124.

DOI: 10.1007/s00217-003-0708-1.

[2] Calin-Sanchez, A.; Lech, K.; Zumny, A.; Figiel, A.; Carbonell-Barrachina, A. A. Volatile Composition of Sweet

Basil Essential Oil (Ocimum Basilicum L.) As Affected by Drying Method. Food Res. Int. 2012, 48, 217–225.

DOI: 10.1016/j.foodres.2012.03.015.

[3] Filip, S. Basil (Ocimum Basilicum L.) A Source of Valuable Phytonutrients. Int. J. Clin. Nutr. Diet. 2017, 3, 118.

DOI: 10.15344/2456-8171/2017/118.

[4] Sonmezdag, A. S.; Amanpour, A.; Kelebek, H.; Selli, S. The Most Aroma-active Compounds in Shade-dried Aerial Parts of Basil Obtained from Iran and Turkey. Ind. Crops Prod. 2018, 124, 692–698.

DOI: 10.1016/j.indcrop.2018.08.053.

[5] Klimankova, E.; Holadova, K.; Hajslova, J.; Cajka, T.; Poustka, J.; Koudela, M. Aroma Profiles of Five Basil

(Ocimumbasilicum L.) Cultivars Grown under Conventional and Organic Conditions. Food Chem. 2008, 107,

464–472.

DOI: 10.1016/j.foodchem.2007.07.062.

[6] Chenni, M.; El Abed, D.; Rakotomanomana, N.; Fernandez, X.; Chemat, F. Comparative Study of Essential Oils

Extracted from Egyptian Basil Leaves (Ocimum Basilicum L.) Using Hydro-distillation and Solvent-free.

Molecules. 2016, 21(113).

DOI: 10.3390/molecules21010113.

[7] Akbari, G. A.; Binesh, S.; Ramshini, H.; Soltani, E.; Amini, F.; Mirfazeli, M. S. Selection of Basil (Ocimum

Basilicum L.) Full-sib Families from Diverse Landraces. J. Appl. Res. Med. Aromat. Plants. 2019, 12, 66–72.

DOI: 10.1016/j.jarmap.2018.12.003.

[8] Shahri, M. M.; Yazdpour, H.; Soleymani, A.; Shahrajabian, M. H.; Sharifzadeh, M. Yield and Yield Components of Ratoon Crop of Rice as Influenced by Harvesting at Different Plant Height and Time. Yield and Yield Components of Ratoon Crop of Rice as Influenced by Harvesting at Different Plant Height and Time. Res. Crops. 2012, 13(2), 408–411.

[9] Ogbaji, P. O.; Li, J.; Xue, X.; Shahrajabian, M. H.; Egrinya, E. A. Impact of Bio-fertilizer or Nutrient Solution on Spinach (Spinacea Oleraceae) Growth and Yield in Some Province Soils of P. R. China. Cercetari Agronomice in Moldova. 2018, 51(2), 43–52.

DOI: 10.2478/cerce-2018-0015.

[10] Soleymani, A.; Shahrajabian, M. H. Influence of Drought Stress on Germination and Seedling Growth Traits of

Cumin. Cercetari Agronomice in Moldova. 2018, 1(173), 91–100.

[11] Shahrajabian, M. H.; Sun, W.; Cheng, Q. DNA Methylation as the Most Important Content of Epigenetics in

Traditional Chinese Herbal Medicine. J. Med. Plants Res. 2019, 13(16), 357–369.

DOI: 10.5897/JMPR2019.6803.

[12] Shahrajabian, M. H.; Sun, W.; Cheng, Q. Clinical Aspects and Health Benefits of Ginger (Zingiberofficinale) in

Both Traditional Chinese Medicine and Modern Industry. Acta Agric. Scand. B Soil Plant Sci. 69(6), 546–556.

[13] Shahrajabian, M. H.; Sun, W.; Cheng, Q. Chinese Star Anise (Illicium Verum) and Pyrethrum (Chrysanthemum

Cinerariifolium) as Natural Alternatives for Organic Farming and Health Care- A Review. Aust. J. Crop Sci. 2020,

14(3), 517–523.

DOI: 10.21475/ajcs.20.14.03.p2209.

[14] Shahrajabian, M. H.; Sun, W.; Cheng, Q. Chinese Herbal Medicine for SARS and SARS-CoV-2 Treatment and

Prevention, Encouraging Using Herbal Medicine for COVID-19 Outbreak. Acta Agric. Scand. B- Soil Plant Sci.

2020.

DOI: 10.1080/09064710.2020.1763448.

[15] Sun, W.; Shahrajabian, M. H.; Huang, Q. Soybean Seeds Treated with Single Walled Carbon Naotubes (Swcnts) Showed Enhanced Drought Tolerance during Germination. Int. J. Adv. Biol. Biomed. Res. 2020, 8(1), 9–16.

[16] Sun, W.; Shahrajabian, M. H.; Khoshkharam, M.; Cheng, Q. Adaptation of Acupuncture and Traditional Chinese Herbal Medicines Models because of Climate Change. J. Stress Physiol. Biochem. 2020, 16(1), 85–90.

[17] https://images.app.goo.gl/fWJpXgAsLD6x2x1u5

[18] Nadeem HR, Akhtar S, Ismail T, Qamar M, Sestili P, Saeed W, et al. Antioxidant Effect of Ocimum basilicum

Essential Oil and Its Effect on Cooking Qualities of Supplemented Chicken Nuggets are as Antioxidants.

2022;11(10):1882.

[19]Barbalho SM, Machado FMVF, Rodrigues JDS, Silva THPD, Goulart RDA. Sweet basil (Ocimum basilicum):

Much more than a condiment. CELLMED. 2012;2(1):3-1.

[20] Miraj S, Kiani S. Study of pharmacological effect of Ocimum basilicum: A review. Der Pharmacia Lettre.

2016;8(9):276-80.

[21] Naji-Tabasi S, Razavi SMA. Functional properties and functions of basil seed gum are as: An overview. Food

Hydrocolloids. 2017;73:313-325.

[22]Cherian R. Health benefits of basil seeds. Int. J. Sci. Res. Sci. Eng. Technol, 2019, 511-515.

[23] Hosseini-Parvar SH, Matia-Merino L, Goh KK, Razavi SM, Mortazavi SA. Steady shear flow behavior of gum extracted from Ocimum basilicum L. seed: Effect of concentration and temperature. Journal of food engineering. 2010 Dec 1;101(3):236-43.

[24]Egata DF. Benefit and use of sweet basil (Ocimum basilicum L.) in Ethiopia: a review. J. Nutr. Food Proces.

2021;4(5):57-9.

[25]Singletary KW. Basil: A brief summary of potential health benefits. Nutrition Today. 2018 Mar 1;53(2):92-7.

[26]Gajendiran A, Thangaraman V, Thangamani S, Ravi D, Abraham J. Antimicrobial, antioxidant and anticancer

screening of Ocimum basilicum seeds. Bull. Pharm. Res. 2016;6(3):114-9.

[27] Pavlova–Student T, Nakov AG. The effect of adding basil whole plant powder (Ocimum basilicum l.) Some

properties of bread 9. Научни трудове.

[28]Akshatha DS, Naik RS, Chethana B, Brundha A. A study on nutritional, functional and anti-nutritional properties of basil seed integrated products suggest; c2019.

[29]Yikmiş S, Özpancar N, Bozkir Ç, Çöl BG. Functional sirkencubin syrup with purple basil; bioactive properties,

organoleptic acceptability, and possible effects on blood pressure. Food Science and Technology. 2020 May

8;40:550-7.

[30]Song KY, Joung KY, Shin SY, Kim YS. Effects of Basil (Ocimum basilicum L.) Seed mucilage substituted for fat source in sponge cake: physicochemical, structural, and retrogradation properties. Italian Journal of Food Science. 2017 Sep 5;29(4).

[31]Patriani P, Hellyward J, Hafid H, Apsari NL. Application of sweet basil (Ocimum basilicum) on physical and

organoleptic qualities of chicken meatballs. InIOP Conference Series: Earth and Environmental Science

2021 Jun 1 (Vol. 782, No. 2, p. 022083). IOP Publishing.

[32]Gaio I, Saggiorato AG, Treichel H, Cichoski AJ, Astolfi V, Cardoso RI, et al. Antibacterial activity of basil

essential oil (Ocimum basilicum L.) in Italian-type sausage. Journal für Verbraucherschutz und

Lebensmittelsicherheit. 2015 Dec;10:323-9.

[33]David J. Preparation of herbal shrikhand prepared with basil (Ocimum basilicum) extract. The Pharma

Innovation. 2015 Oct 1;4(8, Part B):81.

[34]Gurkan HACER, Hayaloglu AA. Volatiles and sensory properties of yogurt manufactured by incorporating basil

(Ocimum basilicum L.). International journal of food properties. 2017;20(sup1):S779-S789.

[35]Munir M, Qayyum A, Raza S, Siddiqui NR, Mumtaz A, Safdar N, et al. Nutritional assessment of basil seed and

its utilization in advancement of value added beverage. Pakistan Journal of Agricultural Research.

2017;30(3):266-271.

[36]Preedy VR. (Ed.). Essential oils in food preservation, flavor and safety. Academic press; c2015.

[37]Abidoye AO, Ojedokun FO, Fasogbon BM, Bamidele OP. Effects of sweet basil leaves (Ocimum basilicum L)

addition on the chemical, antioxidant, and storage stability of roselle calyces (Hibiscus sabdariffa) drink.

Food Chemistry. 2022 Mar 1;371:131170.

[38]Takwa S, Caleja C, Barreira JC, Soković M, Achour L, Barros L, Ferreira IC. Arbutus unedo L. and Ocimum

basilicum L. as sources of natural preservatives for food industry: A case study using loaf bread. LWT. 2018 Feb

1;88:47-55.

[39]Haynes S. 16 Evidence-Based Health Benefits of Holy Basil or Tulasi; c2022.

[40] Malireddy, S., et al. Phytochemical antioxidants modulate mammalian cellular epigenome: implications in health and

disease. Antioxid Redox Signal, 2012. 17(2): 327-339.

[41] Doughari, J.H., et al. Phytochemicals: Extraction Methods, Basic Structures and Mode of action as Potential

Chemotherapeutic Agents, Phytochemicals - A Global Perspective of Their Role in Nutrition and Health, 2012. 978-

953.

[42] Saxena, M., and Saxena, J. Phytochemistry of medicinal plants. Journal of Pharmacognosy and Phytochemistry,

2013.1: 2278-4136,

[43] Kliebenstein, D.J., and Osbourn, A., Making new molecules - Evolution of pathways for novel metabolites in

plants. Curr Opin Plant Biol, 2012. 15:415-23.

[44] Patra, B., et al. Transcriptional regulation of secondary metabolite biosynthesis in plants. Biochim Biophys Acta, 2013.

1829; 1236-1247.

[45] Havsteen, BH., The biochemistry and medical significance of the flavonoids. Pharmacol Ther, 2002. 96: 67-202.

[46] Dewick, PM., The Shikimate Pathway: Aromatic amino acids and phenylpropanoids, in medicinal natural products: A

biosynthetic approach, (3rd edn). Chichester, UK: John Wiley & Sons, Ltd, NY, USA. 2009.

[47] Warsi, A.R., Sholichah, IOP Conf. Ser.: Mater. Sci. Eng. 2017. 259: 012008.

[48] Shuaib, O.R., et al. Comparative Nutritional and anti-nutritional analysis of Ocimum grattissimum and Ocimum

basilicum. Academia Arena, 2015. 7(7): 77-81.

[49] Antolovich, M., et al. Methods for testing antioxidant activity. Analyst. 2002. 127:183-198,

[50] Gulcin, I., et al. Anti-oxidant and analgesic activities of turpentine of Pinus nigra Arn. subsp. pallsiana (Lamb)

Holmboe. Journal of Ethanopharmacology, 2003. 86: 51-58