Organoleptic Properties of a Standardised Food Product (Cookies) Developed from Beet Root Extract and Bengal Gram Flour

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Abstract

Food product development is the need of society today. The food products are available in the market but lack nutritional quality. Therefore in present study there is a need of society and industry to produce new food products. We have developed beet root cookies with the combination of Bengal gram flour , beet root and sesame seeds. We have taken different ratios of the main ingredients and cookies were developed by incorporating the beetroot extract and Bengal gram flour in four in the ratio i.e. 50:50, 60:40, 70:30 and 80:20. The beet root was grinded and the extract was taken out with sieving and pressing. Then in the Bengal gram, Maida, sesame seeds, Butter , Sugar and the extraxt was mixed to prepare the cookies. A panel of Ten experts from field of Nutrition were selected to mark the food samples in different ratios. Four samples were made and Sample B scored highest on hedonic scale of sensory evaluation. This resulted that Sample B was acceptable in terms of Color, Taste, Texture , After taste and Overall aceeptability.

Keywords: Beet Root; Extract; Bengal Gram; Food Product; Cookies.

Introduction

Beetroot is the hardy and cool season vegetable crop which is grown throughout the world . It has been classified as B. vulgaris and belongs to genus Beta and family Chenopodiaceae and is usually known by several names like beet, sea beet, chard , garden beet, chukander (in hindi). It is basically the taproot portion of beet plant [1]. The earliest form of beetroot is the wild sea beet and is the source for all different beetroot varieties available today. Beetroot requires an ideal temperature of about 18 to 25 Degree Celsius and does not grow well in extreme hot and extreme cold weathers. It grows well in deep and well drained, loose, loamy to sandy soils that is free from large stones. The best suitable pH that is required for beetroot cultivation is 6.0 to 7.0. Acidic soils should be avoided. Cultivation of beetroot requires a lot of water and frequent irrigation in drought and summer season so it is better to sow this crop on arrival of monsoons.

A one cup serving of boiled beets contain 74 calories, very low fat i.e. 0.15g and 2g of fibre. It also meet the 17% of vitamins daily intake based on 2,000 calorie intake and 14% of mineral daily intake. Beetroot is having glycaemic index of score 61 and glycaemic load is only 5 which means that it does not have major effect on blood sugar level. Due to antioxidant, antiapoptosis and anti-inflammatory properties, beetroot has a renal protective potential [2]. In ancient times, beetroot was believed to enhance human sex hormones and as an aphrodisiac and the juice of beetroot was also consumed to expel kidney and bladder stones [3]. It is a natural food that can be used to boost the energy in athletes. The latest study suggest that beetroot juice shows its performance at peak at 2-3 hours after ingestion. The requirement of the oxygen to maintain a level of moderate exercise after consuming beetroot juice decreases in amount . The best results show the declining level of oxygen consumption by about three percent. Researchers also found that the acute ingestion of 2 bottles of beetroot juice concentrate will show maximal effect on exercise capacity [4] and 6 days of beetroot juice supplementation has shown a significant improvement in 10-km cycle TT performance [5].

Beetroots are high in betaine, a nutrient that helps

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protect cells, proteins and enzymes from environmental stress and also help to fight inflammation, protect internal organs, which is used to lower toxic levels of Homocysteine (Hcy) (this contributes to development of heart disease, stroke and peripheral vascular disease) so it is a potential herb used in cardiovascular disease [6]. Moreover Beta vulgairs var. rubra has shown tumor inhibitory effects in skin and lung cancer [7]. Recent research shows that beetroot provides a high number of antioxidants. Moreover it is a significant source of dietary polyphenols [8]. It can also improve the clinical outcomes of Type 2 Diabetes. Many studies proved that beetroot also contribute to improve the haemoglobin level in blood. Hence a study was conducted by to evaluate the effectiveness of beetroot juice on haemoglobin level among adolescent girls. This study concludes that the all adolescent girls who are anaemic can take the beetroot juice for 20 days to improve their haemoglobin level [9]. It has been also claimed that beets helps in building red corpuscles and add tones to blood so that haemoglobin level increases.

The nitrate supplementation provided by beetroot juice improves exercise tolerance through vascular control and elevated oxygen delivery to skeletal muscles [4]. Furthermore beetroot juice was found to have blood pressure lowering and vaso protective effects [10]. A daily intake of one glass of beetroot juice can lower blood pressure in people with hypertension. In general, dietary intake of nitrate or nitrite has proved beneficial to NO-mediated physiological effects in humans, such as regulation of blood pressure, vascular control and enhanced vasodilation [11,12]. A new study by researchers at Wake Forest University has shown that daily consumption of beetroot juice can foster brain health in older adults .Consumption of beetroot leaves are beneficial for faster healing of wounds [13].

Gram flour is known as garbanzo bean flour or besan and it is a white pulse flour made from ground chickpeas or channa dal. It is also known as gram in some of the Asian countries and kaalachanna in both Hindi and Urdu or chhola boot. It is a staple ingredient in Indian, Pakistani, Nepali and Bangladeshi cuisines. It can be made from either raw or roasted gram beans. It is believed to be one of the oldest pulses known and cultivated in Asia and Europe. According to Aykoid and Doughty (1964), the eastern Mediterranean is stated as the centre of origin of Bengal gram, but its probable place of origin lies in Southwestern Asia i.e. countries like Afganistan and Persia. According to De Candolle, Sanskrit name "Chanaka" of Bengal gram flour indicates that the crop was under cultivation in India longer than in any country in the world.

Besan flour contains 387 calories per cup. It also has 11 grams of sugar, 22 grams of protein, 7 grams of fat, 11 grams of fiber and 58 g of carbohydrates. 75% of lipid content present in besan is unsaturated fatty acids in which linoleic acid comprises 43% of total fat. One third of the starch present in besan is Amylose, which is a slowly digested starch that helps to feel full longer. It is a protein rich supplement to cereal based diets, especially to poor in developing countries, where people cannot consume or afford animal protein or are vegetarians. The pulse proteins contain high amount of lysine and have low sulphur containing amino acids. Gram seeds contain high percentage of oil (4-5%) than other pulses. The glycaemic index of Bengal gram flour is just 10 which is low so it is a great food for diabetes. Blended Bengal gram flour can be used with wheat flour to make "basini roti" which is mainly unleavened bread commonly consumed by diabetic patient. Neutral detergent fiber present in Bengal gram flour can also lower glucose level in body so it can be used for control of diabetes [14]. Being rich in iron, consumption ofbesan on daily basis can help the body to recover from iron deficiency like anaemia. A study also stated that regular consumption of pulses performs a protective effect on risk for cardiovascular diseases. Pulses also contain a rich variety of compounds, which if consumed in sufficient amount may help to reduce tumour risk. Bengal gram flour contains molybdenum which is a mineral that is used to detoxify sulphites (a preservative found in wine, meat and salad in salad bars) [15]. It provides dietary calcium as about the same as yogurt and close to milk. It also possesses hypolipidemic action. It has been suggested that natural carbohydrates, especially rich in dietary fiber may protect against atherosclerosis and may reduce hypercholesterolemia so Bengal gram flour can be used to prevent these diseases. Several studies also reveal that fiber rich diet i.e. diet containing Bengal gram flour can minimise the toxic effects of pesticides [14]. Exiting antioxidant properties of raw and cooked chickpeas is due to presence of carotenoids [16], total polyphenol and tannins [17]. So inclusion of Bengal gram in daily diet will afford protection against many of the disorders.

Sesame seeds are known to be as the oldest condiments. They are tiny, flat oval seeds with a nutty taste. Sesame (Sesamumindicum L.) belongs to the Pedaliaceae family and also known by several names like benniseed, gingelly, simsim, til etc. It was a major oilseed crop in the ancient world due to its easiness,

great stability and resistance to drought. India, China and Mexico are the largest commercial producers of sesame seeds. They are given more importance just because of their oil which is resistant to rancidity.

Sesame seeds grow best in well-drained soil with a medium texture and neutral pH. They require 90 to 120 frost free days and temperature above 23 degree Celsius. Moreover these crops are drought tolerant due to extensive root system.

Sesame seeds have the highest oil content as compared to rapeseed, peanut, soybean and other oil crops, it is rich in oil (50-60%), protein (18-25%), carbohydrate and ash. Oils of sesame seeds are used as raw material in the manufacture of linoleic acid which is a therapeutic nutrient with antioxidant and anti-tumor therapeutic properties. Moreover monounsaturated fatty acids present in seeds helps in removing dangerous LDL cholesterol from arteries and blood vessels, thereby preventing against atherosclerosis, heart attack and strokes. The impressive levels of essential minerals like zinc, calcium and phosphorus helps to maintain body's bone health and prevent osteoporosis. Moreover phosphorus is also required for kidney function, cell maintanence and maintaining body's acid-alkaline balance so sesame seeds also serves this function in the body. They have also been found to have immunoglobulin E [18]. They also contain the lignans, sesamolin, sesamin, pinoresinol and lariciresinol [19] [20]. Organic compound sesamol in sesame seeds have been associated in protecting DNA against the harmful effects of radiation. Magnesium present in these seeds have shown protective effect against asthma and other respiratory disorders by preventing airway spasms. Black seeds increase the liver blood therefore beneficial for liver and also for nourishing the eyes.sesameseds contain phytate which is a cancer preventing compound and reduces the impact and effect of free radicals.it is also known to cure bleeding dysentery, burns ear pain , headache and impotency.

Maida is known as white wheat flour without any bran in south india and it is basically finely milled refined and bleached white flour. It is made from the endosperm of the grain. The limiting use of maida in preparation of leavened breads is just because of the denaturation of protein by the heat generated during milling process.

Materials and Method

Procurement of Raw Material

Beetroot were purchased online from Big Basket

Store. The raw materials were physically examined to ensure they were disease free and stored in a cool temperature. Bengal gram flour, Maida and salt were purchased from local market, Panipat, Haryana, India. Sesame seeds, vanilla essence, Baking powder, butter were purchased from Departmental store in Amity university, Manesar, Haryana, India. Castor sugar was obtained from Spar, MGF Mall, Gurgaon. Sesame seeds were milled in a grinder to obtain sesame powder and Beetroot was milled to obtain Beetroot extract. All the ingredients are carried to Nutritional lab of Dietetics and Applied Nutrition, Amity university, Haryana.

Standardisation of Food Product

The recipe for cookies was standardised using the

S. No.	Ingredients	Quantity (in grams)
1.	Maida	170g
2.	Sesame seeds	63g
3.	Baking powder	2g
4.	Salt	0.2g
5.	Vanilla essence	2g
6.	Castor sugar	100g
7.	Beet root	125 -200g
8.	Bengal gram flour	50-125g

following

After the standardisation of the ingredients, the ingredients are being proceed for development.

Baking requires the dough to be gentle. The magic of baking comes in full taste when the dough is the appropriate one. The type of dough and flour affects the structure and texture of the cookies. Handling of dough requires much techniques like more of whisking .The contents of the dough (Maida, Bengal gram flour etc) should be measured with precision.. As we are using Bengal gram flour which is a high protein flour thus it absorbs more moisture making the dough a drier and tougher one. Thus to make coookies soft some amount of maida is also added in the dough.The kneading of the dough should be proper so that no lumps are formed and the dough is a smooth one. The apt dough for the cookies is the one that is little harder than the normal dough we use to make chapatis. It should be supple and when broken into pieces less incisions should be visible.

Development of Food Products (Cookies)

Using the above standardised recipe, cookies were developed by incorporating the beetroot extract and Bengal gram flour in four ratio i.e. 50:50, 60:40, 70:30, 80:20. The method used in developing these cookies

are as follows.

First of all, Beetroot was peeled and cut into small pieces. These small pieces of beetroot undergoes grinding in grinding machine until a thin form of beetroot extract was obtained. Then Beetroot extract was collected in a bowl. Sesame seeds were roasted in frying pan over gas fuel and then kept for few minutes so that their temperature comes to room temperature. Then these sesame seeds are grinded until they take a form of powder and collected in a bowl.

Then four bowl of same size were collected to make four variations and marked as A, B, C, D. Ingredients including 170g of Maida, 4g of vanilla essence, 2g of baking powder, 100g of castor sugar and a pinch of salt were added into all four bowl to form dough of cookies. The appropriate amount of beetroot extract and Bengal gram flour was weighed using an electronic balance to give the various ratios of this mixture.

Beetroot and Bengal gram flour were added to all four bowl according to their quantities in different variation. To make the variation A, 50% of beetroot (125g) and 50% of Bengal gram flour (125) were added to bowl marked as A. To make variation B, 60% of beetroot (150g) and 40% of Bengal gram flour (100g) were added to bowl marked as B. To make variation C, 70% of beetroot (175g) and 30% of Bengal gram flour (75g) was added to bowl marked as C. To make variation D, 80% of beetroot (200g) and 20% of Bengal gram flour (50g) was added to bowl marked as D. Butter was melted in pan over gas and poured over the mixtures in all four bowl. All the ingredients added in different bowl undergoes mixing separately to form a suitable dough. The dough of all four varieties was left for 10 minutes to achieve better results.

The dough of variety A was shaped into rectangle, dough of variety B was shaped into circle, dough of variety C was shaped into triangle, dough of variety C was shaped into square. OTG is pre-heated at 180 degree Celsius for 10 minutes and OTG tray was greased with butter to avoid sticking of dough to tray. Then these shaped dough were kept into tray for baking turn by turn with variety A undergoing baking at first then followed by variety B, then by variety C and then by variety D. All the variations undergo baking at temperature of 170C-180C for 20 minutes. After the cookies were baked, all the cookies were kept in different containers marked as A, B, C, D.

Sensory Evaluation of Food Product

Then sensory evaluation of four samples were being

done at 9 point hedonic scale. For each variation , 20 hedonic tests were conducted by 20 different panellists /experts from the field of Nutrition. Hedonic tests were done on the basis of

- Taste
- Colour
- Texture
- Firmness
- Crispiness
- Overall

Each individual gave his rating on the basis of his likes or dislikes. After conducting the sensory evaluation, statistical analysis was done. This was done on the basis of Mean and Standard deviation of all attributes. In statistical analysis we jot down all the points given by the individual in different attributes.

Result and Discussion

After the sensory evaluation the product were statistically analysed using Mean and Standard deviation. According to above information, we got to know that following samples have following attributes.

Sample A

Taste: The sample had mean 8.85± 0.85 scores depicting the taste factor. It was felt by the experts that both the ingredients i.e. beetroot and Bengal gram flour tasted equally.

Colour: The sample hadmean 9.1± 0.83 scores in this aspect and it's colour was quite similar to red as beetroot content was highest in it. As colour factor is very important because the food is at first seen by the eyes so the Sample A had an attractive red colour.

Texture: The sample had mean 8.6 ± 1.24 scores in texture and it was observed as crumbly and thin in texture and had a smooth top so it resembles the texture required for cookies.

Firmness: The sample had mean 8.5 ± 1.24 scores depicting the firmness factor and firmness was not ideal as it was supposed to be because it was quite difficult to break and chew.

Crispiness: The sample had mean 8.8 ± 0.87 scores in crispiness and it had a crisp taste and rated as second in this aspect.

Overall: Overall this sample was accepted by the

panellists upto much of the extent as all the ideal factors required for cookieswas not met and had 8.9±1.26 mean scores.

Sample B.

Taste: The sample had same mean scores as that of A i.e. 8.85±1.27 as it was also felt to have taste of both the ingredients equally .

Colour: The sample hadsimilar mean scores to that of A i.e. 9.15 ±1.01 but not exactly same as A and it possessed light red colour which was more appealing than sample A and more suited to the texture of this sample.

Texture: This sample had highest mean scores among all the samples i.e.9.1±0.88 and it was observed by experts as quite puffy with a fine and smooth top so it was considered as ideal sample among all.

Firmness: This sample was rated bestin this aspect among all and it had 9.05±0.92 mean scoresand it's firmness was similar to that required by the cookies i.e. neither too hard nor too soft and chewy also.

Crispiness: The sample had 9±2.35 mean scores in this aspect and it was crisp enough around the edges which adds on to the more appealing quality of this sample and can be easily crumbled.

Overall: Overall this sample was most accepted by panellists as it was rated best in all the attributes and had 9.5±1.14 mean scores.

Sample C

Taste: The sample had 8.35±0.79 mean scores in taste and it was observed after tasting that this sample had a bitter after taste so it did not satisfy the taste buds as compared to other samples.

Colour: This sample had 8.25± 0.82 mean scores depicting the taste factor and it was light red along with black finish. Vision stimulates taste thus the colour was not so eye relishing.

Texture: The sample had 8.55±0.92 mean scores in texture .It was found to have high flakiness and lack of puffiness thus the sample was not considered. It was thin, coarse and rough in texture.

Firmness: The sample had8.45±0.80 mean scores in firmness. Hard foods are not easily accepted and the sample was quite hard to break thus not accepted.

Crispiness: The sample had 8.5±0.80 mean scores in this aspect . The high crispiness made this sample hard to chew.

Overall: Overall this sample was accepted by onlysome of the panellists and it had 8.25±0.82 mean scores. Due to this sample lacking in all the considered aspects this sample was ranked on the third place.

Sample D

Taste: This sample was worst in taste due to high beetroot content which gave this sample a bitter taste.It had least 8.1±1.04 mean scores in this aspect as it was not liked.

Colour: This sample had 8.2±1.07 mean scores in colour and it was dark in colour i.e. a mixture of black and light reddue to the black colour this sample was not eye catching.

Texture: This sample had least mean scores among all the samples i.e. 8.15 ±1.10. It's texture was thin and craggy. Due to hard texture it became more tasteless .

Firmness: This sample had firmness above average so it was too hard to break and not easily chewable. It had least mean scores in terms of firmness i.e. 8.1±0.94.

Crispiness: This sample was too much crispy to chew and the crust was burnt which was not at all tasty so it had least mean scores i.e. 8.3±1.1 in this aspect.And was ranked at the last.

Overall: Overall this sample was not at all liked by the people as it has worst ratings in all of the attributes so it had 7.9±0.99 mean scores. The panellists rejected this sample mainly due to its exceeding firmness after taste .

It is clearly seen that sample containing 60% Beetroot (150g) and 40% Bengal gram flour (100g) is rated best followed by sample containing 50% beetroot (125g) and 50% Bengal gram flour (125g) , which is followed by sample containing 70% beetroot (175g) and 30% Bengal gram flour(75g) while the sample containing 80% beetroot (200g) and 20% Bengal gram flour (50g) is least rated.

All these results are calculated on the basis of standard deviation and mean of the samples. The cookies prepared from 80% beetroot (200g) and 20% Bengal gram flour (50g) i.e. sample D was very difficult to break as their firmness was above average. Moreover their texture was not too much appealing and they also taste bitter. Sample A i.e. 50% of beetroot (125g) and 50%of Bengal gram flour(125g) is not found as much as significant like B on other attributes like texture, colour, firmness. The reviews of patents also revealed that sample C i.e. 70% of beetroot 9175g) and 30% of Bengal gram flour(75g) was over baked. The storage capacity of these cookieswereobserved it

was found that these cookies can stay upto 6 – 7 days without addition of preservatives.

The result thus indicates that the panellist accepted the cookies prepared from 60% beetroot(150g) and 40% of Bengal gram flour (100g) at the most.

Chemical Composition of Cookies

Chemical composition of accepted cookies having 60% beetroot (150g) and 40% Bengal gram flour (100g) are summarized in Table 2. With the increase in beetroot content there is decrease in protein content.

Conclusion

After the evaluation of chemical composition, vitamin and mineral analysis of sample B i.e. 60% beetroot(150g) and 40% Bengal gram flour (100g), It has been concluded that sample B is rich in protein and iron. Moreover sample B results best in all the attributes as compared to other. It is also found that there is no difference in cooking time with change in amount of beetroot and Bengal gram flour. The results of this study are good indicators of the possibilities of better utilisation of beetroot and Bengal gram flour through developing variety of new food products. Around 5 cookies of sample B will almost meet the requirement of protein and iron. Though these cookies are iron rich it can be a good option for people who are suffering from anaemia.

References

1. "Beet". def. 1 and 2.also "beet-root". Oxford English Dictionary Second Edition on CD-ROM (v. 4.0) © Oxford University Press 2009.

2. Ali A. El Gamal, Mansour S. AlSaid, Mohammad Raish, Mohammed Al-Sohaibani, ShazaM. Al-Massarani, Ajaz Ahmad, MohamedHefnawy, Mohammed Al-Yahya, Omer A. Basoudan, and Syed Rafatullah .Beetroot (Beta vulgaris L.) Extract Ameliorates Gentamicin-Induced Nephrotoxicity Associated Oxidative Stress,Inflammation, and Apoptosis in Rodent Model.Mediat. Inflamm.2014, 2014.p.983–952.

3. N. Sharma, B. Tanwer, and Vijayvergia, "Study of medicinal plants in Aravali. Region of rajasthan for treatment of kidney stone and urinary track troubles", International journal of pharm Tech Research, 2011;3(1):110-113.

4. Wylie et al., L.J. Wylie, J. Kelly, S.J. Bailey, J.R. Blackwell, P.F. Skiba, P.G. Winyard, A.E. Jeukendrup, A. Vanhatalo, A.M. Jones Beetroot juice

and exercise: pharmacodynamic and dose–response relationshipsJournal of Applied Physiology (1985), 2013; 115(3):325–336.

5. Cermak, N.M., Gibala, M.J., and van Loon, L.J. Nitrate supplementation's improvement of 10-km time-trial performance in trained cyclists. Int. J. Sport Nutr.Exerc.Metab. 20121;22(1):64–71.

6. L.Vali, E.Stefanovits-Banyai, k.Szentmihalyi, H.Febel, E.Sardi, Lugasi, A. kocsis, A.Blazorics, "Liver-protecting effects of table beet (Beta vulgaris varRubra) during ischemia – reperfusion, "Nutrition 2007;23:172-178.

7. Kapadia, G.J., Tokuda, H., Konoshima, T., Nishino, H., "Chemoprevention of lung and skin cancer by Beta vulgaris (beet) root extract,"Cancer Letters, 1996;100:211–214.

8. Peter C. Wootton-Beard, Lisa Ryan . A beetroot juice shot is a significant and convenient source of bioaccessible antioxidants Journal of Functional Foods 2011;3:329-334.

9. Dr. N. Gayathri Priya, Mrs. M. Malarvizhi, Mrs.AnnalJegaJothi . Beet root juice on haemoglobin among adolescent girls. IOSR Journal of Nursing and Health Science (IOSR-JNHS) e-ISSN: 2320–1959.p-ISSN: 2320–1940, 2013 Sep-Oct;2(1).

10. V. Kapil, A.B. Milsom, M. Okorie, S. Maleki-Toyserkani, F. Akram, F. Rehman, S. Arghandawi, V. Pearl, N. Benjamin, S. Loukogeorgakis, R. Macallister, A.J. Hobbs, A.J. Webb, A. Ahluwalia Inorganic nitrate supplementation lowers blood pressure in humans: role for nitrite-derived NO Hypertension, 2010;56(2):274–28.

11. Dejam, C.J. Hunter, M.T. GladwinEffects of dietary nitrate on blood pressureThe New England Journal of Medicine, 2007;356(15):1590.

12. Maher et al., 2008A.R. Maher, A.B. Milsom,P. Gunaruwan, K. Abozguia, I. Ahmed, R.A. Weaver, Thomas, H. Ashrafian, G.V. Born, P.E. James, M.P. FrenneauxHypoxic modulation of exogenous nitrite-induced vasodilation in human Circulation, 2008;117(5):670–677.

13. A.Singh, V.K. Garg, P.k. Sharma, and S.Gupta, "Wound healing activity of ethanolic extract of beta vulgaris," pharmacologyonline, 2011;1:1031-1038.

14. Indira M and Kurup PA, Effect of black gram fiber on toxic effects of organophosphorus insecticides, Indian J ExpBiol, 1980;18:1529.1

15. Murray MND. Health benefits benefits of Bengal gram flour. THeEncyclopedia of Healing Foods. New York: Atria Books. 2005.

16. Stahl, W. And Sies, H. Antioxidant activity of carotenoids.Molecular aspect of medicine 2003;(24)6: 345-351.

17. Scalbert, A., Monach, C. ,Morand, C., Jimenz, L. Dietary polyphenols and the prevention of diseases. Critical reviews in food science and nutrition

2005;(45)4: 287-306.

18. Agne, P.S.E., Rance, F. and Bidat, E. Sesame Seed Allergy. Rev. Franc. Allergol.Immunol.Clin. , 2003;43:507-516. [Shows sesame to contain immunoglo-bulin E (IgE)-mediated food allergens and highlights what could be the cause].

19. Milder, Ivon E.J.; Arts, Ilja C.W.; Betty; Venema, Dini P.; Hollman, Peter C.H. "Lignan contents of Dutch plant foods: a database including lariciresinol, pinoresinol, secoisolariciresinol and matairesinol".

British Journal of Nutrition. 2005;93:393–402.

20. Kuo PC, Lin MC, Chen GF, Yiu TJ, Teen JT. "Identification of methanol-soluble compounds in sesame and evaluation of antioxidant potential of its lignans". J Agric Food Chem. 2011;59(7):3214–9.

21. C.gopalan,B. V. Rama Sastri and S. C. Balasubramanian. Nutritive value of Indian Foods.National Institue of NutritionIndian Council of Medical Research (ICMR) Hyderabad.