

Medicinal Uses of Cashew (Anacardium occidentale): Review

¹Zarqa Iqbal, ²Muhammad Akram, ²Muhammad Muddasar Saeed, ²Marium Ahsan
³Muhammad Daniyal, ⁴Aamir Sharif,

²Muhammad Talha Khalil, ²Hina Anwar, ²Fahad Said, ⁵Muhammad Riaz

¹School of Mechanical and Manufacturing Engineering, National University of Science and
Technology, Islamabad Pakistan,

²Department of Eastern Medicine, Government College University
Faisalabad Pakistan,

³TCM and Ethnomedicine Innovation & Development International Laboratory, Innovative Drug
Research Institute, School of Pharmacy, Hunan University of Chinese Medicine, Changsha,
P.R.China,

⁴Department of System Emotional Sciences,
Faculty of Medicine,

Graduate School of innovative life Sciences,
University of Toyama, Toyama 930-0194, Japan

⁵Department of Allied Health Sciences, Sargodha Medical College, University of Sargodha,
Pakistan

Abstract: The cashew nut is essential for physical and emotional well-being. It is an energetic diet and the best food medication for many illnesses. Nuts protect from malignant growth, coronary illness, circulatory strain, and various degenerative infirmities connected to aging. It can be used for several medicinal purposes. Every part of cashew has some important medicinal properties. Cashew kernel contains proteins, carbohydrates, vitamins, and fats which help gain energy. Cashew nuts are used for many purposes like blood sugar, weight loss, cancer, cold and flu, aging, urinary disorders, digestive disorders, and bone relaxation. In comparing cashew with other nuts, Cashew kernels have good properties, including proteins, carbohydrates, fibers, and minerals, then almond, hazelnut, and walnuts. Cashew kernels contain the highest number of proteins (21%) when compared with Almonds (20.8%), Hazelnuts (15.6%), and Macadamia Nuts (60.9%). Cashew contains a large amount of carbohydrate (22%) compared to other nuts like almonds, walnuts, etc. There are some strong benefits of Cashew for health. They boost the immune system, act as an antioxidant, remove gallstones, and are beneficial for anemia. They are good sources of healthy fats that are necessary for our body to absorb fat-soluble vitamins.



Corresponding Author: Zarqa Iqbal

*School of Mechanical and Manufacturing Engineering,
National University of Science and Technology,
Islamabad Pakistan.*

Mail: izarqa15@gmail.com

Its bark is known as the antihypertensive and glucose-lowering part. It has beneficial effect on the eyes and skin. This is rich in vitamin C, so it can be used for skin problems like acne, flawless freckles, skin lines and protects from aging.

Keywords: Antihypertensive, coronary illness, protein, carbohydrate, fiber

Introduction:

Cashew is an evergreen perennial plant belonging to the family Anacardiaceae. This family consists of 400-600 species. Among the eight species in the genus Anacardium, the only cashew is valuable due to its nutritious kernel. Cashew is a tropical tree present in South America and Brazil. Plant height varies from 5 to 14 m. The trunk is usually short and irregular, starting branches close to the ground. Leaves are green that are placed in a spiral pattern towards the end of the stem. Leaves become mature after 20-25 days. Flowering can occur at any time; individual flowers are short in size consisting of five yellowish-green sepals and five white to reddish petals. In 2011, about 4.7million tons of raw nuts were produced worldwide, which were distributed between Asia and Africa, where 1.8 million cashew apples were produced [1].

Cashew has been cultured essentially, and whole fruit is used for medicinal and food purposes, e.g., apple and kernel. Cashew gained its importance during World War II due to the utilization of its significant by-product, the cashew nut shell liquid (Cordeiro ; Rico, Bulló et al. 2016). The Cashew nut has nutritious properties with a pleasant flavor. Cashew kernels have shown low-density lipoprotein cholesterol levels and coronary risk diseases. Cashew part contains proteins and fats. The proteins include lysine, cysteine, arginine tyrosine, valine, and many vitamins like vitamin C, E, D [2].

Cashew gum has been used widely for many health-related issues. These are less in saturated fatty acids and more in unsaturated fatty acids. Its health benefits have been used to decrease the risk of cardiovascular diseases, oxidative stress, inflammation, high cholesterol, and diabetes [3].

Cashew nuts are used for several medicinal purposes and have great importance related to health, as evidenced by research [4]. These are used for obesity, diabetes, heart disease, urinary disorders, digestive disorders, and many other clinical applications like bone relaxation, cold and flow, etc. It also has importance in Cancer, and protects from aging [5].

CASHEW COMPOSITION:

The nuts of Cashew are present in the regions of north-eastern Brazil, similar to kidney seed shape appearance that holds the lower part of this, the product of the tree. It is a favorite dried organic product that has excellent and brilliant taste. During the 16th century, the Portuguese familiarized cashew with India and Africa. The Cashew tree has great importance, as its valuable

wood has analgesic effect, the cashew itself didn't acquire notoriety in the start of the twentieth century. Now India is the biggest country in making, processing, and exporting cashew bits on the earth. It is used as a mixed drink or in foods to distribute bread rolls, frozen yogurts, and chocolates. It can also be utilized for natural products, juice, liquor, desserts. The cashew nutshell fluid is extracted from shell comprises as destructive astringent oil valuable in brake coating, paints, and plastics [6].

CASHEW REFINING:

These nuts are to be prepared to remove palatable bit which is profoundly nourishing. In India, it is collected during long periods of April and May and promoted rapidly from that point. The external surface of cashew is thick and slightly thin internal surface. The pieces that are obtained during preparation are of various evaluation like wholes, parts, and bits, etc.

ROLE OF CASHEW NUTS IN HEART DISEASES:

As nuts have been selected that they are not suitable food due to their high-fat substance. But recent studies suggest that nuts might be beneficial for the heart. About 66% of cholesterol comes from the liver, not from food, its creation being animated by soaked fat. Soaked fat itself can be dangerous for the heart. Soaked fats are discovered prevalently in synthetic items, including dairy items. However, people can reduce their cholesterol level by using food containing low-soaked food and more unsaturated fats. Recently, tree nuts have been developing a great medical advantage. For example, previous studies from epidemiological and clinical examinations have shown that tree-nut is helpful for the heart diseases.

Cashew part that is less in soaked fat and more in monounsaturated fat lessens the general degrees of cholesterol and low-density lipoproteins (LDL) - the claimed "bad cholesterol" that prompts coronary disease and builds high-density lipoproteins (HDL), hence assisting in making the heart more sound [7]. The Cashew part contains fiber, carrying more fiber into the diet brings down the level of cholesterol and the danger of heart disease prominently, which is known as heart nibble. The fiber in the digestive tract lessens the assimilation of cholesterol from food consumption. Ordinary use of these nuts, as a feature of a low-soaked fat eating routine, can bring down the danger of coronary disease overall by advantageously influencing the cholesterol levels in blood and can reduce the risk of having a subsequent respiratory & cardiovascular failure[8].

CASHEW NUTS FOR DIABETES :

Daily utilization of food that is rapidly increasing the sugar level in the blood leads to developing heart diseases and diabetes as Cashew nuts contain high mono saturated fat that is beneficial for decreasing the blood glucose level and increase insulin production. Thus, diabetes can be managed by cashew pieces. They are essential for type 2 diabetes. They are lower in sugar and

higher in fiber; when these factors are combined, they decreased the blood glucose level and prevent the development of type 2 diabetes [9].

CASHEW NUTS FOR RHINITIS:

As Cashew parts are rich in vitamin B, an ordinarily occurring cell strengthening which has invulnerability high power. Consequently, burning through cashew parts during winter and cold season will improve an individual's insusceptibility [10].

CASHEW NUTS FOR OBESITY:

Harvard University declared that a healthy food contains copious fat from the nuts of tree and olive oil has a strong agent for weight reduction as a small calorie, kept for a low eating regimen and a great benefit for weight reduction [11]. These nuts are rich in supplements and fiber that they will, in general, fulfill appetite on less energy than other snacks [12]. Cashew extract causes significant reduction in total cholesterol, triglycerides, LDL and VLDL cholesterol [13].

PROTECTION FROM CANCER:

This disease can likewise get destroyed from nuts. Selenium - rich cashew bits are helpful for lung, liver, skin, cerebrum, and gastrointestinal malignancy. Due to significant fiber content likewise assists with fighting malignancy. They act as an antioxidant and prevent the growth of cancer cells by removing the free radicals from the body. A class of flavonoids called Proanthocyanidins fight tumor cells and prevents them from further division. High copper content and proanthocyanidins in cashew nut fight copper content in cashew helping to prevent colon cancer [14].

EYE PROTECTION:

Today's women are selecting to work at home by using mobile phones and laptops continuously, which damage their eyes. Zeaxanthin is a pigment that is present in Cashew, by the consumption of Cashew, will protect the retina from damaging the UV rays and hence protects the eye.

FOR SKIN:

We all want fresh, flawless, and glowing skin and avoid cosmetic products for damaged skin. By eating a few Cashews daily, we can be protected from acne and damaged skin. This is the most beneficial effect of Cashew nut for charming and glowing skin[15-22]

HELPFUL FOR AGEING:

Vitamin E has extra ordinary boosting power. A new investigation conducted on 65 years old people found that Vitamin E supplementation appeared to stop the decrease in insusceptibility related to aging. 100g of cashew pieces contain 46mg of Vitamin E, in this way protecting from aging as cashew contains free radicals that keep the body free from wrinkles and lines in the face. Cashew is used in skin remineralization and in the treatment of premature aging [23-32].

RENAL ROLE:

Potassium is an essential element to protect the human renal system. As it contains sodium and potassium, so, it can be used to treat dehydration and essential minerals, which are suitable for the kidneys. 28.35gm of cashew portion gives 0.00015kg of potassium. Potassium is a common mineral is acquire on a regular basis excepts from delicate coconuts and cashew nuts [33-37].

ROLE IN DIGESTIVE DISORDERS:

Cashew contains 1.30% fiber. Dietary fiber is beneficial for stomach-related issues. It maintains water, soothes the stool, and removes the blockage. Thus, it is beneficial for hemorrhoids, varicose veins, hiatal hernias, and diverticulosis.

COPPER AS AN ANTIOXIDANT, ENERGY BUILDING & BONES:

Copper plays a vital role in physiological aspects of life like iron use, bone and connective tissue improvement and essential for skin and hair colors. Copper is a basic fundamental part of the protein, superoxide dismutase, which plays a key role in providing energy and cancer prevention. It is essential for the action of lysyl oxidase, a special protein associated with cross-linked collagen and elastin, which provides support to bones, joints and flexibility to bones. They act as an antioxidant and reduce inflammation as they contain free radicals and keeps the body healthy.

CASHEW FOR BONES AND NEURALGIA:

About 22.3% of magnesium is present in one-fourth cup of cashews. It contains calcium, magnesium which are essential for nerve and muscle tone. It acts like a natural calcium channel blocker that keeps calcium from rushing into the nerve cell and enacting the nerve. By regulating the calcium entrance, that will keep the nerves loose.

Recent studies have shown that magnesium decreases the recurrent attack of headache, lowers the circulatory strains, cardiovascular failures, manages hormonal influences in women during menopause, and lowers the seriousness of Asthma [38].

ROLE OF CASHEW KERNEL:

Cashew kernels are purified from raw cashew. These are soft, white, and meaty but change the color and taste upon roasting. They are attached with shells and classify them carefully by food companies around the world. These are dried to lose the skin and then peeled off [18]. Cashew part contains protein (18.22g), carbohydrates (27.13g), and fat (46.92g) per 100g. These have lower fat content than other nuts containing oleic acid, which is essential for the cardiovascular system [39].

The lipid parts of Cashew are rich in unsaturated fats, which include oleic acid and polyunsaturated fats. As this is free from cholesterol and contains a fixed amount of monosaturated fat, which is best for lowering the cholesterol level [40]. However, cashew has

the most powerful benefits for health, including heart, nerve functioning, and muscle, maintain bone strength and oral health. These are good source of vitamins and dietary fats, which are good for our health to absorb fat-soluble vitamins [41].

These are classified into three types; white/scorched wholes, pieces, and splits. They are low in sugar and rich in proteins, fibers, and healthy fats. They also contain important minerals and vitamins like calcium, magnesium, and copper, which are essential for the production of energy, brain health, immunity, and strengthen the bone. In addition, it contains calcium, phosphorus, copper, zinc, iron, magnesium, and sodium. As Cashew parts give the energy of 611KCal/100g, and this is an equal amount that of almond (612Kcal/100g). In addition, it contains minerals like Calcium, Phosphorus, Sodium, Potassium, Magnesium, Iron, Copper, Zinc, and Manganese. It is highly rich in starch. Oligosaccharides of cashew part are, for the most part, galactosyl sucrose. These kernels give an oil that can be used as a mechanical and chemical antidote for irritant poison [42].

CASHEW APPLE:

This is the fruit of cashew tree. It is red or orange in color. These are rich in vitamin C, so can be used for diseases that can be developed due to the deficiency of vitamin C, like for skin. These are preserved in glass jars. Cashew apple is a pseudo-organic product that is a delicious natural and nutritious. The fleshy part of cashew is known as cashew apple. These contain sugars, tannins, phenols, amino acids, ascorbic acid, minerals and fiber. The cashew apple has a sweet flavor having delicate skin. Cashew apple gives an anti-scorbutic property. Hence the juice of this apple can be used as diuretic, for the treatment of renal diseases, and for cholera. Cashew apple juice can be used for pharyngitis and chronic dysentery. The brandy of cashew apple can be used to relieve the pain in Neuralgia and rheumatism. The amount of ascorbic acid, solvent solids, decreasing sugars and all out acids were found to change among outskirts and focus of the cashew apple. As Cashew apples are rich in amino acids that has a property like aspartic acid, alanine, proline, leucine, and glycine [43].

CASHEW GUM:

Cashew gum (CG) is a biopolymer extracted from the exudate of *Anacardium occidentale*, a typical tree of Brazil's north eastern locale. The gum chain is made out of galactose (72%), with side-chains of arabinose (4.6%), glucose (14%), rhamnose (3.2%) and uronic acid (4.7%). CG properties were discovered to be like those of gum Arabic. Fundamental oils are unstable, vanishing effectively, and can deteriorate when presented to light, heat or potentially pressure. The encapsulation of fundamental oils intends to safeguard and secure their useful properties, notwithstanding give a controlled delivery in a given medium. Nuts are energy-thick food varieties, for the most part because of their high fat substance. These food varieties are low in immersed saturated fats (SFAs) and high in unsaturated fats. Also, nuts contain large amount of fiber, folate, minerals, and cancer preventing agents. Because of their dietary creation, broad exploration has been completed on nuts and wellbeing results, for example, diminished danger of

cardiovascular diseases and related risk factors like oxidative stress and irritation, high cholesterol and diabetes.²⁰ Considering the observed advantages of nut utilization on heart wellbeing, the US Food and Drug Administration (FDA) delivered a wellbeing guarantee perceiving that these food sources may diminish the risk of coronary diseases from the leafy foods and utilized in culinary that point forward, nuts have been fused into rules for smart dieting in a few countries. Tree nuts are characterized as dry natural products with one seed in which the ovary divider turns out to be hard at development. Peanuts (*Arachis hypogea*), albeit organically delegated vegetables, have a comparable supplement profile to tree nuts and subsequently are normally remembered for this gathering. Selenium is a fundamental micronutrient with cell reinforcement limit that guides in distinctive physiological cycles like invulnerable framework balance, substantial metal and xenobiotic detoxification, and thyroid chemical guidelines [44],[45].

CONCLUSION:

The cashew tree is present in Brazil, where being a natural product is viewed as an intricacy. In the sixteenth hundred years, the Portuguese familiarized cashew with other countries like some African nations and India. Cashew nuts have flavorful bites and great health benefits. They are rich in calories, as 100g of nuts give 553 calories. They contain dissolvable fiber, nutrients, minerals, and different wellbeing advancing phyto-synthetic substances that are beneficial for infections and tumors. In addition, it's a fact that cashews have less fat substance than other different nuts, around 75% of their fat is unsaturated fats, in addition to about 75% of this unsaturated fat substance is oleic acid. As studies shown that oleic acid is important for heart diseases, even in people with diabetes. They can be used for protection of eyes and skin. As, this is rich in vitamin C, so beneficial for all issues of skin like acne and freckles etc. They additionally contain monosaturated fats, copper and great amount of phosphorus and magnesium. When compared with green leaf and vegetables, cashew contains less level of oxalic acid which is important during calcium dissemination.

It is a beneficial medication for reducing craving, depressive symptoms, sadness, disappointment, anxious, shortcoming, scurvy, paleness, and treatment of stomach, chest, urinary and liver problems. After research its proven that cashew portions could formed into a herb to treat the snakebites, nut oil can be applied for cracked heels, or as a fungal specialist. The natural product, bark and leaves are utilized for treating parasitic action, for wounds, rashes, and can be used as an antipyretic, and for diarrhea. However, these nuts have less amount of cholesterol, thus its very beneficial for those individuals who have cardiac issues. Moreover, there is additionally mono unsaturated fat substance that makes a difference producing good cholesterol and boost the blood circulation. They have monstrous wholesome properties that could be investigated further and utilized as prospective convenient and useful food. A few worth added items can be prepared by the leafy foods and utilized in culinary. Further research is needed to investigate the biopharmaceutical effects of Cashew.

REFERENCES:

1. Allen, K. G., L. M. Klevay, et al. (1977). "The zinc and copper content of seeds and nuts."
2. Bes-Rastrollo, M., J. Sabaté, et al. (2007). "Nut consumption and weight gain in a Mediterranean cohort: the SUN study." *Obesity* 15(1): 107-107.
3. Cardoso, B. R., G. B. S. Duarte, et al. (2017). "Brazil nuts: Nutritional composition, health benefits and safety aspects." *Food Research International* 100: 9-18.
4. Cordeiro, T. A. "A REVIEW ON THE NUTRITIONAL ASPECTS AND HEALTH BENEFITS OF CASHEW (ANACARDIUM OCCIDENTALE)." *Principal's Message*: 85.
5. Davis, C. D. (2003). "Low dietary copper increases fecal free radical production, fecal water alkaline phosphatase activity and cytotoxicity in healthy men." *The Journal of nutrition* 133(2): 522-527.
6. de Oliveira, E. F., H. C. Paula, et al. (2014). "Alginate/cashew gum nanoparticles for essential oil encapsulation." *Colloids and Surfaces B: Biointerfaces* 113: 146-151.
7. Dendena, B. and S. Corsi (2014). "Cashew, from seed to market: a review." *Agronomy for sustainable development* 34(4): 753-772.
8. Allen, K. G., L. M. Klevay, et al. (1977). "The zinc and copper content of seeds and nuts."
9. Bes-Rastrollo, M., J. Sabaté, et al. (2007). "Nut consumption and weight gain in a Mediterranean cohort: the SUN study." *Obesity* 15(1): 107-107.
10. Cardoso, B. R., G. B. S. Duarte, et al. (2017). "Brazil nuts: Nutritional composition, health benefits and safety aspects." *Food Research International* 100: 9-18.
11. Cordeiro, T. A. "A REVIEW ON THE NUTRITIONAL ASPECTS AND HEALTH BENEFITS OF CASHEW (ANACARDIUM OCCIDENTALE)." *Principal's Message*: 85.
12. Davis, C. D. (2003). "Low dietary copper increases fecal free radical production, fecal water alkaline phosphatase activity and cytotoxicity in healthy men." *The Journal of nutrition* 133(2): 522-527.
13. Fetuga, B., G. Babatunde, et al. (1975). feedingstuff potential of cashewnut scrap kernel meal. *Proceedings of the Conference on Animal Feeds of Tropical and Subtropical Origin*.
14. Fraser, G. E. (1994). "Diet and coronary heart disease: beyond dietary fats and low-density-lipoprotein cholesterol." *The American journal of clinical nutrition* 59(5): 1117S-1123S.
15. Hu, F. B., J. E. Manson, et al. (2001). "Types of dietary fat and risk of coronary heart disease: a critical review." *Journal of the American college of Nutrition* 20(1): 5-19.
16. Layokun, S., A. Obawole, et al. (1986). "Investigation of cashew apple juice as a substrate for single cell protein production." *Journal of Food science* 51(1): 237-238.
17. Maia, J. G. S., E. H. A. Andrade, et al. (2000). "Volatile constituents of the leaves, fruits and flowers of cashew (*Anacardium occidentale* L.)." *Journal of food composition and analysis* 13(3): 227-232.
18. Nagaraja, K. (1987). "Lipids of high-yielding varieties of cashew (*Anacardium occidentale* L.)." *Plant Foods for Human Nutrition* 37(4): 307-311.
19. Nayudamma, Y. and C. Koteswara Rao (1967). "Cashew testa: its use in leather industry." *Industrial Cashew Journal* 4: 12-13.

20. Odunsi, A. (2002). "Effect of feeding reject cashew kernel meal on pre and early-laying performance of pullet." *Archivos de Zootecnia* 51(196): 423-429.
21. Oliveira, N., R. Leal, et al. (2015). "The importance of the cashew nut (*Anacardium occidentale* L.) coat: a review." *American International Journal of Contemporary Scientific Research* 2(8): 09-41.
22. Patil, P. (2017). "Indian cashew food." *Integr Food Nutr Metab* 4(2): 1-5.
23. Rani, T. J., K. Prasad, et al. (2017). "Evaluation of antiobesity activity of ethanolic extract of cashew apple against high fat diet induced obesity in rodents." *The FASEB Journal* 31: 1b565-1b565.
24. Rico, R., M. Bulló, et al. (2016). "Nutritional composition of raw fresh cashew (*Anacardium occidentale* L.) kernels from different origin." *Food science & nutrition* 4(2): 329-338.
25. Santos, B., G. Juliano, et al. (2013). "Modelling the acidification curve of tropical fruits: cashew apple, coconut, kiwi, mango, papaya, red guava, watermelon and yellow melon." *International Food Research Journal* 20(2): 763.
26. Schirato, G. V., F. M. F. Monteiro, et al. (2006). "O polissacarídeo do *Anacardium occidentale* L. na fase inflamatória do processo cicatricial de lesões cutâneas." *Ciência Rural* 36(1): 149-154.
27. Karthick, R., et al. "Overcome the challenges in bio-medical instruments using IOT–A review." *Materials Today: Proceedings* (2020). <https://doi.org/10.1016/j.matpr.2020.08.420>
28. Karthick, R., et al. "A Geographical Review: Novel Coronavirus (COVID-19) Pandemic." *A Geographical Review: Novel Coronavirus (COVID-19) Pandemic* (October 16, 2020). *Asian Journal of Applied Science and Technology (AJAST)(Quarterly International Journal)* Volume 4 (2020): 44-50.
29. Sathiyathan, N. "Medical Image Compression Using View Compensated Wavelet Transform." *Journal of Global Research in Computer Science* 9.9 (2018): 01-04.
30. Karthick, R., and M. Sundararajan. "SPIDER-based out-of-order execution scheme for Ht-MPSOC." *International Journal of Advanced Intelligence paradigms* 19.1 (2021): 28-41. <https://doi.org/10.1504/IJAIP.2021.114581>
31. Sabarish, P., et al. "An Energy Efficient Microwave Based Wireless Solar Power Transmission System." *IOP Conference Series: Materials Science and Engineering*. Vol. 937. No. 1. IOP Publishing, 2020. [doi:10.1088/1757-899X/937/1/012013](https://doi.org/10.1088/1757-899X/937/1/012013)
32. Vijayalakshmi, S., et al. "Implementation of a new Bi-Directional Switch multilevel Inverter for the reduction of harmonics." *IOP Conference Series: Materials Science and Engineering*. Vol. 937. No. 1. IOP Publishing, 2020. [doi:10.1088/1757-899X/937/1/012026](https://doi.org/10.1088/1757-899X/937/1/012026)
33. Karthick, R., and M. Sundararajan. "Hardware Evaluation of Second Round SHA-3 Candidates Using FPGA (April 2, 2014)." *International Journal of Advanced Research in Computer Science & Technology (IJARCST 2014)* 2.2.
34. Karthick, R., et al. "High resolution image scaling using fuzzy based FPGA implementation." *Asian Journal of Applied Science and Technology (AJAST)* 3.1 (2019): 215-221.

35. P. Sabarish, R. Karthick, A. Sindhu, N. Sathiyathan, Investigation on performance of solar photovoltaic fed hybrid semi impedance source converters, *Materials Today: Proceedings*, 2020, <https://doi.org/10.1016/j.matpr.2020.08.390>
36. Karthick, R., A. Manoj Prabakaran, and P. Selvaprassanth. "Internet of things based high security border surveillance strategy." *Asian Journal of Applied Science and Technology (AJAST) Volume 3* (2019): 94-100.
37. Karthick, R., and M. Sundararajan. "A novel 3-D-IC test architecture-a review." *International Journal of Engineering and Technology (UAE) 7.1.1* (2018): 582-586.
38. Karthick, R., and M. Sundararajan. "Design and implementation of low power testing using advanced razor based processor." *International Journal of Applied Engineering Research* 12.17 (2017): 6384-6390.
39. Karthick, R., and M. Sundararajan. "A Reconfigurable Method for TimeCorrelatedMimo Channels with a Decision Feedback Receiver." *International Journal of Applied Engineering Research* 12.15 (2017): 5234-5241.
40. Karthick, R., and M. Sundararajan. "PSO based out-of-order (ooo) execution scheme for HT-MPSOC." *Journal of Advanced Research in Dynamical and Control Systems* 9 (2017): 1969.
41. Karthick, R. "Deep Learning For Age Group Classification System." *International Journal Of Advances In Signal And Image Sciences* 4.2 (2018): 16-22.
42. Karthick, R., and P. Meenalochini. "Implementation of data cache block (DCB) in shared processor using field-programmable gate array (FPGA)." *Journal of the National Science Foundation of Sri Lanka* 48.4 (2020). <http://doi.org/10.4038/jnsfsr.v48i4.10340>
43. Suresh, Helina Rajini, et al. "Suppression of four wave mixing effect in DWDM system." *Materials Today: Proceedings* (2021). <https://doi.org/10.1016/j.matpr.2020.11.545>
44. M. Sheik Dawood, S. Sakena Benazer, N. Nanthini, R. Devika, R. Karthick, Design of rectenna for wireless sensor networks, *Materials Today: Proceedings*, 2021. <https://doi.org/10.1016/j.matpr.2020.11.905>
45. M. Sheik Dawood, S. Sakena Benazer, R. Karthick, R. Senthil Ganesh, S. Sugirtha Mary, Performance analysis of efficient video transmission using EvalSVC, EvalVid-NT, EvalVid, *Materials Today: Proceedings*, 2021. <https://doi.org/10.1016/j.matpr.2021.02.287>