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Utilization of cashew nut waste: Cashew apple and shell

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Abstract
Cashew tree cultivation is done primarily aiming cashew nut production. The large amounts of cashew shells are considered as agricultural waste and the by-product of cashew nut production. The cashew shell has high amount of oil content in it and can be used in various feedstocks. It is available in abundance during the summer in almost all parts of the world and is reported to possess high valuable products in utilization of food, medicine, chemical and allied industries. It is also useful as raw material for many industrial applications. However, the natural oil phenol, Bio-based monomers and various chemical structure of cashew nut have various ways in research and focused principally on the generation of significant worth included items. So as to understand the maximum capacity of cashew nuts and its mixes, information on preparing and use instruments fundamental deterioration is required. In the present paper, the creators made an endeavor to audit the writing on important use of cashew nutshell.
Also, the cashew apple waste is used as a form of energy bagasse's, fermented cultures used in probiotics also the waste is used for conditioning of soil. Initially cashew apple is full of vitamins and minerals so after extraction of juice some residue is left in it which helps in fermentation process further. The astringency containing tannin is manufactured by extraction from the cashew apple.

Keywords: Cashew nut shell, cashew apple, nutritional waste utilization

1. Introduction
The Cashew (*Anacardium occidenatale* L.) was first introduced in India at Goon coast from the Portuguese sailor in 16th century. The species is natively from Central America, Northern South America and including Caribbean island and Brazil (Aiyadurai, 1966) [1]. Cashew is mainly known for its nuts. The small nut, kidney shape attached to it, is widely used while the cashew nut shell and cashew apple is considered as waste. The total waste of cashew nut shell per kg of cashew nut is about 60 % and cashew apple is 40%. The byproducts of cashew can be used as a substrate for several microbial fermentation processes and also used as feed in petrochemical feedstock unit (Akinwale, 2000) [2]. In this review cashew nut shell and cashew apple with their own nutritional value, waste utilization has been studied. Processing of cashew is economically viable and the information is also useful to strengthen the present processing industries.

2. Botany of cashew
The cashew tree is a tropical evergreen tree produces cashew nut and cashew apple. The tree grows up to 14 m (46 ft.) stature, however predominate cashew becomes about 6m (20 ft.) has been cashew becomes demonstrated increasingly gainful with better return and prior development (Asogwa *et al.,* 2008) [3]. The genuine natural product is the cashew tree is a kidney or boxing-glove formed drupe that develops at end of the cashew apple the drupe grows first on the tree, and afterward the pedicle ventures into the cashew apple inside the genuine organic product is a solitary seed, the cashew (Kubo *et al.,* 1993) [4]. The organic product is thick, with oval seeds, 2-3 cm long. The seeds are rosy - dark colored cleaned with two enormous cotyledons and a little undeveloped organism. Its shell comprising a clingy ruddy dark colored fluid contains different substance nut parts (de Abreu *et al.,* 2013) [5].

3. Medicinal attributes

3.1 Cashew shell nutritional properties

The oil extracted from cashew shell is anti-bacterial and also can heal wound known as traditional medicine anciently used by the travelers. Also, it is used for treating ulcer and tooth abscesses beside as a condition of leprosy and psoriasis. It also has other properties which can be used for treating cancer and myocardial infection (Garruti *et al.,* 2003; Berry *et al.,* 2011) [6, 7].

3.2 Cashew apple nutritional properties

Glucose in the cashew apple acts as an instant energy supplier whereas fructose in the cashew apple regulates the insulin and stabilizes the blood sugar level. The calcium in the cashew apple helps in joints and bone wellness. The copper consisting in cashew apple helps in flexibility of blood vessel and increasing in oxygen carrying capacity (Dendena and Stefano, 2014) [8]. Cashew apple is also known for its antioxidant property and oral cleanser, it maintains oral freshness, strengthen the gum and overall dental health. The fresh and fermented product of cashew apple helps to prevent macular degeneration, muscle cramp and insomnia in old age. According to Indian Council of Medical Research, the average body requirement of Vitamin C is about 40 mg to 80 mg and the requirements can be fulfilled by consuming 100 ml of cashew apple juice (Mukunthan *et al.,* 2012) [9].

4. Waste utilization

4.1 Cashew nut shell liquid or Cashew oil

Cashew Nut Shell Liquid is utilized adaptable crude material with wide applications in types of surface covering, generation of polymers just as paints and varnishes, it is additionally utilized in the creation of asbestos with free grating synthesis of brake linings, likewise as a finisher with elevated level of strength and flexibility for compound coats (da Silveira *et al.,* 2015) [10]. Important concoction present in the pyrolysis of CNSL at high temperature (450 ^{0}C TO 750 ^{0}C) and short living arrangement time required. The results of pyrolysis incorporate hydrocarbons, gases and phenols with high petrochemical esteems (Gordon *et al.,* 2012) [11].

4.2 Cashew nut shell cake

Cashew shell cake or cashew shell oil cake is utilized in boilers, heating, consuming or utilized as fuel by assembling units. Cashew nutshell cakes gives tremendous temperature when heating legitimately or blending in with different powers or fuel substitutes (Prommajak *et al.,* 2018) [12]. CNSL cake is the perfect fuel where high heat requires to be produced and it gives extremely long timeframe of realistic usability. It is fundamentally utilized by the concrete lively and tiles producers (Kubo *et al.,* 1099) [13].

4.3 Cashew nut shell waste as animal feed

Cashew shell waste is also used for animal feed in poultry, fishes, piggery as the de-oiled cashew waste is fermented and mixed with wheat stalks so to provide a material for the animal meal (Cavalcante *et al.,* 2003) [14].

4.4 Cashew feed from cashew apple waste

Waste of cashew apple is largely products in processing industries. This waste can be used as feed source in dairy and piggery units. After the extraction of juice, the cellulose rich processing unit waste (pomace) can be used has high nutrient rich poultry and cattle feed in wet or dry format. Its content high dry matter (22.5%) and protein content (13.7%) and low crude protein (11.8) in cashew apple can be a great potential poultry or cattle feed (Damasceno *et al.,* 2008) [15].

4.5 Bio-surfactants from cashew apple waste

Bio-surfactants are the compounds super-active which can decrease superficial solids and interfacial tension between solids, liquids, and gases. Nowadays most of the surfactants are synthesized chemical which results in toxic and non-biodegradable substances (Gopalan *et al.,* 1999) [16]. Bio surfactants are be used as food, pharmaceutical, environmental application as emulsifier, foaming detergent, solubilizing agent etc. Bio-surfactants can be produced by cashew juice which is not used in by-products due to its different unsuitable compounds, with the use of p.*arruginosa* ATCC-10145 (Gunjate *et al.,* 1995) [17].

4.6 Cashew apple waste as bagasse's

The cashew cake bagasse's containing cellulose 19-24%, hemicelluloses 12 %, lignin 22-38%. Xylose is abundant in the monomer unit of cashew hemicellulose. However, the strain native to it *Saccharomyces cerevisiae* cannot utilize xylose. But some strains of *Candida, Kluyveromyces* and *Pichia which* can be modified *S. cerevisae strain,* can convert xylose to ethanol (Kubo *et al.,* 2006) [18].

4.7 Cashew apple waste as probiotic strain

Probiotics are micro-organisms that survive ingestion in certain numbers to provide various health benefits for human body. However, probiotics are mainly made up of dairy product due to which some lactose intolerance people cannot consume the dairy probiotic milk. The minimal requires count of bacteria in probiotic foods are 7-log CFU/mL. Cashew juice *apple Lactobacillus casei* NRRI B-442 contains about 8-log CFU/mL which is viable amount of count with 42 days of storage capacity (Kubo *et al.,* 2018; Morton *et al.,*2019) [19, 20].

5. Future Prospect of Cashew apple

Cashew waste has the potential to withstand with various products in market due to its high nutritive and chemical compound its can be versatility used in the different field like Food, Pharmaceutical, etc. The Cashew nut shell liquid have a high demand in heat requiring industries as well as in petrochemical field industries. Also, cashew apple is readily available in as it is considered as waste or the 2nd byproduct cashew tree after cashew nuts. Cashew apple contains a high amount of tannin contain. Tannin acyl hydrolase is an enzyme catalyzes in hydrolysis reaction and various other form of reaction so the cashew apple tannin content can be used in this form. Cashew apple goes readily under fermentation process so the process can be used for the production of different cultures under controlled conditions. Future Research and development can help in formation of various products a waste by products from cashew apple by putting a modern technology aspect ahead.

6. Conclusion

Hence, Waste from Cashew apple and shell can be considered as a valuable raw material which has a potential market in domestic and international forum. Though there are some limitations, in chemical and physical processing steps they can be cover up by treating them by various technical steps and a quality and palatable of waste product with significant nutritive properties. This forum and comprehensive content a vast study of cashew waste utilization its nutritive medicinal,

preservation, processing with its waste utilization. Thereby, Future Research and development to be done.

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