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Review

# Are *Bombax buonopozense* and *Bombax malabaricum* possible nutraceuticals for age management?

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ABSTRACT

Human longevity and healthy ageing though controversial require extended investigations. Some studies have shown that ageing can be managed by reducing the amounts of free radicals the cells are exposed to. Oxidative stress has been shown to be combated by antioxidants and plant sources are known to generate antioxidants that are efficacious and low in toxicity. This review aims to enlighten on antioxidants from *Bombax buonopozense* and *Bombax malabaricum* for prevention, reversal or delay of age-related diseases. Furthermore, it advocates for more studies to enable the shift from research to commercial applications of the antioxidants as nutraceuticals in age management.

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## Introduction

Ageing involves gradual biological and psycho-social changes in humans over time. While a person ageing may expand in knowledge and wisdom, physiologically, a gradual decline sets in. As ageing sets in, cell proliferation decreases which implies that the auto-mechanism of renewal and regeneration of cells is slowed down. Furthermore, the body's ability to fight diseases is on the decline due to pathological changes and hence decreased immunity. The elderly begin to observe increased susceptibility to drug adverse effects and drug interactions due to the increased number of drugs that is required to combat diseases they are prone to. There are more than 300 theories of ageing which have been reviewed (Medvedev, 1990) and they include endocrine theories, wear and tear theories, protein error theory, structural stabilization and cross-linkage theories, stress theory, pleiotropy theory, senescence theory, and the most prominent are mitochondrial — free radical theories (Harman, 1998; Medvedev, 1990; Rattan, 2006; Viña et al., 2007).

Some of these theories are inter-woven and only one theory does not fully describe ageing. For instance, mitochondrial theory of ageing suggests that accumulation of mitochondrial damage is a key participant in the normal ageing process (Jeppesen et al., 2011). Mitochondrial damage is precipitated by free radicals and hence mitochondrial theory is interwoven with free radical theory of ageing. Furthermore, based on Burton's review, research findings suggest that cellular

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senescence which is an irreversible growth arrest of mitotic cells contributes to ageing and one of the mechanisms that trigger cellular senescence is oxidative stress (Burton, 2009). Free radicals theory also known as theory of oxidative stress proposes that free radicals cause cell damage (senescence). Oxidative stress is accentuated by the inability of the body to maintain a balance (homeostasis) despite the environmental changes. The homeostasis of an organism is maintained by the presence of substances such as amino acids and vitamins. However, when there is quantitative shortage of these substances, there is alteration in homeostasis and a qualitative alteration will decrease the performance of the organism thereby reducing the maximum life-span (Semsei, 2000). The depletion of amino acids and vitamins are precipitated by several factors which include drugs, stress, malnutrition and dehydration leading to increase in free radicals and subsequently, cell damage and loss of function.

## Oxidative stress

This prominent theory or hypothesis of ageing, oxidative stress theory postulates that accumulation of macromolecular damage is due to redox imbalance between the amount of free radicals generated and the counter-acting antioxidative defense forces (Gil del Valle, 2010). Free radicals called reactive oxygen species (ROS) such as superoxide anions, hydroxyl radicals and hydrogen peroxide; reactive nitrogen species and reactive chlorine species are products of metabolic activities as well as environmental impact. ROS are permitted at transient levels as they are essential in maintenance of homeostasis (Holbrook and Ikeyama, 2002). However, the free radicals generated can attack cellular macromolecules such as proteins, lipids and mitochondrial DNA. The damage of the mitochondria is crucial for ageing (Barja, 2004; Lenaz, 1998) and a number of human diseases (Halliwell, 1999). Free radicals are generated in the body by energy generating process such as metabolism, presence of harmful organisms such as bacteria and viruses as well as unhealthy thoughts and emotional distress (Malhi et al., 2010; Semsei, 2000).

Although, the oxidative/free radical theory of ageing is controversial due to conflicting research findings (Buffenstein et al., 2008; Zimniak, 2008) the fact remains that free radicals damage cells. Buffenstein et al. (2008) argued based on outcomes of a number of studies for and against oxidative stress theory. One of such studies against oxidative stress theory is the study using *Drosophila* that did not produce a correlation between lifespan and ROS production. Also some studies show that some long living animals such as naked mole-rats, white-footed mice and some bat species have high levels of oxidative damage at young age with no adverse effect (Buffenstein et al., 2008; Zimniak, 2008). In sum, the conflicts of research findings are due to choice or lack of animal models, difficult interpretation of results, techniques used and some studies being merely correlative (Beckman and Ames, 1998).

**Table 1**
Biomarkers that indicate the presence of oxidative damage in some chronic diseases.

| Disease condition | Biomarkers | References |
|---|---|---|
| Chronic obstructive pulmonary disease | $H_2O_2$ exhalation, lipid hydroperoxides, carbonyl proteins | Repine et al. (1997) |
| Chronic kidney disease | Plasma carbonyl proteins, free $F_2$-isoprostane content, protein reduced thiol content | Oberg et al. (2004) |
| Alzheimer's disease, diabetes, inflammatory bowel disease, arthritis | Carbonyl proteins | Dalle-Donne et al. (2003) |
| Autism | Methionine, *S*-adenosylmethionine (SAM), *S*-adenosylhomocysteine (SAH), adenosine, homocysteine, cystathionine, cysteine | James et al. (2004) |
| Atherosclerosis | Chlorotyrosine (ClTyr), nitrotyrosine (NO2-Tyr), and dityrosine | Onorato et al. (1998) |
| Atherosclerosis, diabetes mellitus, asthma, Parkinson's disease | Malondialdehyde | Dalle-Donne et al. (2006) |
| Rheumatoid arthritis, systemic sclerosis, lupus erythematosus, chronic lymphedema | 4-Hydroxy-2-nonenal | Dalle-Donne et al. (2006) |
| cardiovascular diseases | 2-Propenal (acrolein) | Dalle-Donne et al. (2006) |
| Cardiovascular and pulmonary diseases | Isoprostanes | Dalle-Donne et al. (2006) |

Buffenstein and co-workers went further to suggest that alternative mechanisms such as autophagy, genomic and protein stability be investigated instead for ageing. However, it is worthy to note that free radicals are implicated in loss of cell integrity, enzyme function, genomic instability (Hensley et al., 2000; Nithiya and Mohan, 2009) and age-related disorders such as cancer, neurodegenerative diseases, diabetes, atherosclerosis, chronic inflammation and rheumatoid arthritis (Gil del Valle, 2010; Halliwell, 1999). Hence, oxidative stress does directly or indirectly influence ageing and consequently, it becomes evident that age-related diseases and age management cannot be investigated in isolation of free radicals/oxidative stress. The role of oxidative stress in chronic disease conditions has been studied using biomarkers. For instance, biomarkers for damage to DNA which leads to development of cancer are thymine glycol and 8-hydroxydeoxyguanine (8-OHdG) and are products of OH damage to DNA. Also the urinary level of oxidized nucleosides is a biomarker of DNA damage (Ashok and Ali, 1999). Some of biomarkers expressed in chronic disease conditions are indicated in Table 1.

Sohal and co-workers in their study of the Mongolian gerbil observed that rate of production of free radicals increased with ageing and the function of the antioxidative defense systems declined with age (Sohal et al., 1995). The human body has defense mechanism systems to combat oxidative damage and these include the presence of substances such as vitamins C and E, selenium, β-carotene, lycopene and lutein, glutathione (GSH) and thioredoxin. These substances prevent or minimize oxidative damage by the application of antioxidant network. Antioxidant network is a process of interactions between antioxidants whereby they regenerate and reactivate one another to produce a synergistic outcome which is cellular sustainability. Because free radicals/antioxidant interaction is a redox process, the antioxidants such as vitamin E may get oxidized to become free radicals. Hence, in the presence of other antioxidants such as vitamin C, oxidized vitamin E is reverted back to vitamin E executing its original function. The interaction between vitamins E and C prevents the attack of vitamin E radical on lipids in the lipoproteins. However, the activities of these body mechanisms or substances decline with age leading to the build up of oxidative damage.

Brandi and co-workers in the study with Mesenchymal stem cells (MSCs) obtained from 5 patients aged 25–43 years reported that oxidative stress induced growth arrest in MSCs; and in comparison with the young cells, the stress tolerance of the old cells were significantly reduced (Brandl et al., 2011). This suggests there is increased susceptibility to oxidative damage with age. The implication of free radicals in age-related diseases and ageing behooves the advocacy of the use of anti-oxidants in age-management.

## Benefits of antioxidants

Although the body has the capacity to combat free radicals; environmental, emotional and mental stresses; and poor eating habits necessitate the need for supplementary anti-oxidants. Antioxidants promote human health in diverse ways which include stimulating the immune system, preventing the heart from damage by free radicals, prevention of cataract (Srivastava and Shivanandappa, 2011).

Antioxidants have been suggested to be the principal strategy to the prevention, delay or even reversal of the process of carcinogenesis (Shyur et al., 2005). Skin ageing due to harsh factors such as ultraviolet rays, excessive dieting and mental stress are treated with antioxidants and topical as well as oral application of antioxidants has been used to promote skin health (Lau et al., 2009). Antioxidants such as selenium exhibit safe and clinically significant antithrombotic activity due to their platelet-stabilizing action (McCarty, 1986). Hence, McCarthy suggested the supplementary antioxidants can be used to prevent myocardial infarction, stroke, post-surgical thromboembolism, vascular complications of diabetes as well as an adjuvant in cancer therapy (McCarty, 1986).

In a review by Rahimi and co-workers on the role of antioxidants in management of diabetes and its complications, studies had attributed diabetic complications such as nephropathy, neuropathy, retinopathy and cardiovascular diseases to oxidative stress (Rahimi et al., 2005). Antioxidants such as vitamins C and E; and plant phytochemicals lowered the indicators of oxidative stress while selenium decreased the susceptibility of LDL to oxidation.

Antioxidants such as polyphenolic compounds have been shown to reduce cardiovascular risks. Red wine which contains polyphenolic compounds have been shown to exhibit antioxidant activities. In a study of individuals with high intake of dairy fats which is known to increase oxidative capacity; concomitant intake of red wine reduced the oxidation of low-density lipoprotein (LDL) thereby retarding the development of coronary heart disease which is one of the complications of atherosclerosis (Maxwell et al., 1994). Frankel and co-workers found out in their study that phenolic compounds in red wine significantly inhibited the copper-catalysed oxidation of LDL by reducing the oxyferryl radical of myoglobin to metmyoglobin (Frankel et al., 1993). Oxyferryl radical of myoglobin is formed by the interaction of equimolar quantities of myoglobin and hydrogen peroxide (Frankel et al., 1993).

In sum, there are a number of reviews indicating the benefits of antioxidants (Fang et al., 2002; Hercberg et al., 1998; Limón-Pacheco and Gonsebatt, 2009; Masaki, 2010; Ratnam et al., 2006; Serafini, 2006). Based on these benefits, there are documentations and ongoing studies on the use of antioxidants for prevention of diseases and acquiring of antioxidants from plant sources which are safe and readily available.

## Plant phenolic compounds as nutraceuticals

The use of nutraceuticals for treatment and management of diseases is certainly not a recent development. Medicinal plants have been in use even before the advent of technology. Furthermore, preventive medicine is not new though there is increasing awareness of it globally. Preventive medicine and promotion of positive health (The Ayurveda system) has been practiced in India about 3500 years ago (Surveswaran et al., 2007). Moreover, while pharmaceutical industries may boast of discoveries, the initial kick-off stemmed from the ancestral or indigenous applications of plants for medicinal use.

The antioxidant activities of most plants are attributed to the presence of phenolic compounds in them. Plant phenolic compounds have been known to have antioxidant activities due to their ability to chelate metals, reduction ability and quenching of singlet oxygen (Rice-Evans et al., 1996). Studies have shown that phenolic compounds of diets/plants are scavengers of reactive oxygen species, reactive chlorine species and reactive nitrogen species (Oke and Aslim, 2011; Oldreive et al., 1998). Traditionally, these plants are used for treatment, management and prevention of diseases. A lot of plants have been explored for their antioxidant activities and studies continue as there are increasing awareness of nutraceuticals and more preference of natural products (due to low toxicity) to synthetic substances. Hence, increased demands require more studies and standardization of nutraceuticals.

*In vivo* studies in humans show promise with plant phenolic compounds. The study on workers occupationally exposed to lead indicated that phenolic compounds such as flavonoids as found in rooibos tea have antioxidant activity (Nikolova et al., 2007). Although there was no significant difference in the blood lead before and after consumption of rooibos tea, lipid peroxidation was reduced preventing further cell damage. In addition, Boots and co-workers' study of the administration of quercetin to non-smoking sarcoidosis patients indicated that the patients may benefit from supplementary antioxidants (Boots et al., 2009). Quercetin significantly reduced the levels of two pro-inflammatory cytokines; TNFα and IL-8 which otherwise was significantly high in sarcoidosis as compared to the control group of healthy non-smoking volunteers. Hence, increase in promotion of preventive medicine and positive health necessitates the need to explore more plants with antioxidant activities to keep up with present and future demands.

## *Bombax buonopozense* and *Bombax malabaricum* plants

*B. buonopozense* P. Beauv and *B. malabaricum* (Fig. 1) are the common *Bombax* species of the family, *Bombaceace.* They have also been categorized under the family Malvaceae. The species are commonly called silk cotton trees and are found in West Africa (*B. buonopozense*), India, Southeast and East Asia as well as Northern Australia (*B. malabaricum*). A common name for *B. buonopozense* is Gold Coast bombax while *B. malabaricum* is known by a host of synonyms: *Bombax ceiba*, *Bombax heptaphyllum* L., *B. malabaricum* DC., *Gossampinus heptaphylla* (Houtt.) Bakh., *Gossampinus malabaricus* (DC.) Merr., and *Salmalia malabarica* (DC.) Schott & Endl.

*B. buonopozense* grow as wild plants in parts of West Africa such as Nigeria. The extract from the stem bark of *B. buonopozense* is used for the treatment of hemorrhoids (Soladoye et al., 2011). Other ethnomedicinal uses of the plant include treatment of impotency (Oni, 2010), candidiasis (Addo-Fordjour et al., 2008), malaria (Asase and Oppong-Mensah, 2009), chest pain (Madge, 1998), stomach ulcer and burns (Agyare et al., 2009). In addition, some scientific studies have been undertaken to validate some of the ethnomedicinal uses. The methanolic extract from the flowers of *B. buonopozense* exhibited significant antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli* and *Aspergillus niger in vitro* (Mann et al., 2011). The antidiarrheal activity was undertaken with the methanolic leaf extract in rats in which diarrhea was induced with castor oil (Christain et al., 2010). The extract decreased intestinal fluid volume and transit as well as frequency of stooling. Furthermore, Akuodor and co-workers evaluated the anti-nociceptive, anti-inflammatory and antipyretic activities of the methanolic leaf extract in mice and rats and observed marked activities comparable to aspirin (Akuodor et al., 2011). The *in vivo* antitrypanosomal study showed that the methanolic extract of the stem bark was able to clear the parasites from the blood within 6 to 7 days of administration (Mann et al., 2010).

In comparison to *B. buonopozense*, there have been more studies on *B. malabaricum.* Ethanolic extract of the root of *B. malabaricum* exhibited significant *anti-Helicobacter pylori* activity (Wang and Huang, 2005). The methanolic extract of the stem bark of *Bombax* (*Ceiba*) *malabaricum (*partitioned with dichloromethane) containing an active agent, lupeol was observed to be antiangiogenic with no significant cytotoxicity (You et al., 2003). In comparison with the reference substance catechin, extract of *B. malabaricum* was found to be a more potent anti-oxidant (Shyur et al., 2005). Currently, there is a commercially available topical cream; Acne-N-Pimple Cream which is made of extract from *B. malabaricum* and other extracts from plants such as *Lenus culinaris* and *Aloe barbadensis.* A clinical trial study was undertaken to assess the efficacy and safety of the cream in



**Fig. 1.** A digital image of *Bombax malabaricum* showing the flower, young stem, root, cotton and leaves. This is an amalgamation of web images obtained from TopTropicals plant catalog, Wikipedia, Forestry Nepal, UBC botanical garden and Hawaiian Ecosystem at risk projects.

management of acne vulgaris (Ravichandran et al., 2004). The study showed significant reduction in blackheads, white heads and inflammation. Although it is a polyherbal therapy and the function of the extract of *B. malabaricum* was not singled out in the study; another study has evaluated its anti-microbial activities against multi-drug resistant *Salmonella typh*i and the methanolic extract of the bark was active (Rani and Khullar, 2004). A recent work on its antimicrobial activities was undertaken on a number of organisms such as *Staphylococcus aureus*, *Streptococcus pyogenes*, *Klebsiella pneumoniae*, *E. coli*, *Klebsiella aerogenes*, *Neisseria gonorrhoeae*, *Pseudomonas aeruginosa*, *Vibrio parahemolyticus*, *Bacillus megaterium*, *Vibrio mimicus*, *A. niger* and *Candida albicans* and extracts from the bark and root was found active against bacteria and fungi employed in the study (Anandarajagopal et al., 2011; Islam et al., 2011).

Other activities of extracts from *B. malabaricum* include hepatoprotection (Chiu et al., 1992; Ravi et al., 2010), cardioprotection (Patel et al., 2011) treatment of sexual debility (Ahmed et al., 1999; Tomar, 2009), wound healing (Ravikumar et al., 2009), sexually transmitted diseases (gonorrhea) (Mia et al., 2009), and antipyresis (Hossain et al., 2011). In sum, the silk cotton tree has been employed to prevent, manage and treat a host of ailments and diseases. Its ethnomedicinal uses have been summarized (Jain et al., 2009).

## Antioxidant activities of *B. malabaricum*

*B. malabaricum* antioxidant activities have also been studied. Jain and co-workers studied the root extract of *B. malabaricum* for its antioxidant activities *in vitro* and *in vivo* (Jain et al., 2011). Its free radical scavenging and reducing power activity were significant. Human volunteers aged 50–60 years were given 3 g of the dried root powder (in capsules) and the total antioxidant status increased by 44% after single dose administration. Also gum extracted from *B. malabaricum* has been indicated to have antioxidant activities (Surveswaran et al., 2007). Methanolic extract of the fresh leaves of *Bombax* (*Ceiba*) *malabaricum* which yielded pure light yellow crystalline powder of mangiferin exhibited strong antioxidant and analgesic activity (Dar et al., 2005). The cytotoxicity testing of mangiferin on 60 cancer cell lines showed inactivity. Water, ethanol and acetone extracts from *B. malabaricum* flowers were investigated for their antioxidant activities which were found to be significant (Yu et al., 2011). Furthermore, Vieira and co-workers' extraction method involved the use of light petroleum ether first, then ether, followed by chloroform and 70% methanol; and the plant extract obtained was shown to contain traces of tannins, alkaloids, flavonoids, sterols, triterpenes, saponins and coumarins by phytochemical analysis (Vieira et al., 2009). The extract showed significant antioxidant activities such as free radical scavenging, inhibition of lipid peroxidation, prevention of oxidation of deoxyribose by scavenging hydroxyl radicals and inhibition of the activity of myeloperoxidase which is suggested to be a catalyst for lipid peroxidation. The cytotoxicity showed toxicity at a con centration higher than required for antioxidant activity (Vieira et al., 2009).

## Compounds isolated from *B. malabaricum*

Some researchers isolated compounds from *B. malabaricum* which were identified and characterized. Sankaram and co-workers extracted six phenolic compounds and a naphthaquinone (BMl–BM7) from the root bark of *B. malabaricum* (Sankaram et al., 1981). About two decades later, Reddy and co-workers extracted Sesquiterpene, Lactone and a naphthaquinone (Fig. 2) from the root bark as well (Reddy et al., 2003). Other researchers have isolated sesquiterpenes from the roots of *B. malabaricum* (Puckhaber and Stipanovic, 2001; Sood et al., 1982). Furthermore, Zhang and co-workers isolated sesquiterpenoids from the air-dried root which were characterized as bombamalones A–D (**1**–**4**) and bombamaloside (**5**) along with four known compounds (**6**–**9**) as shown in Fig. 2 (Zhang et al., 2007).

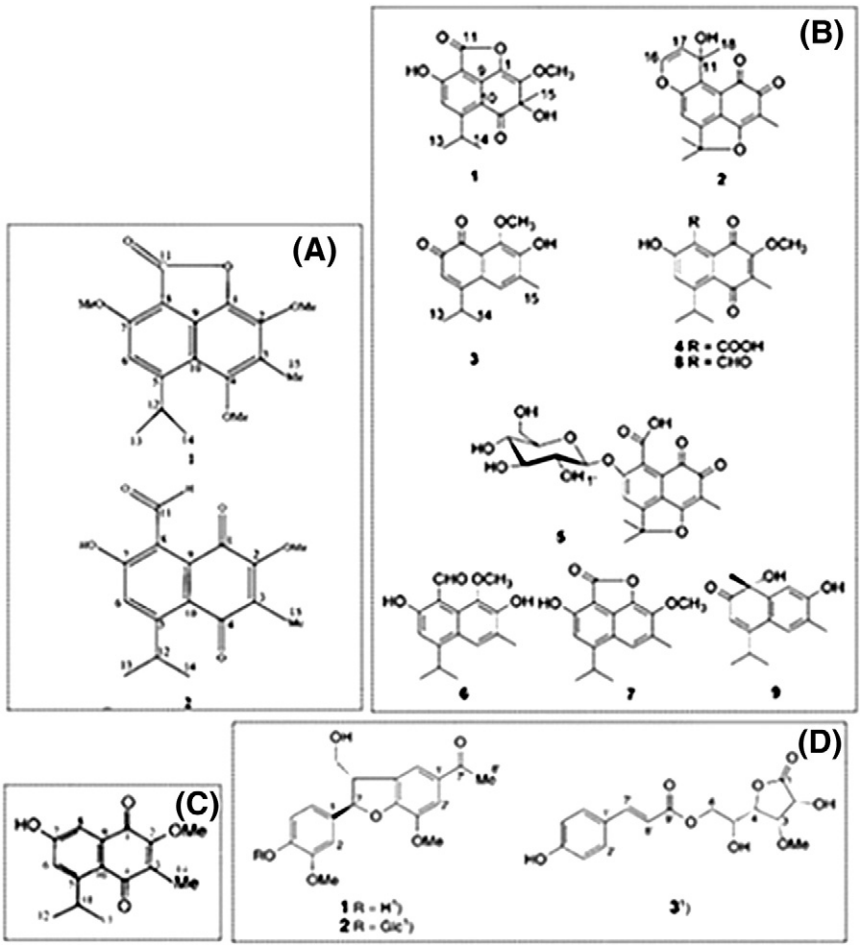


**Fig. 2.** Structures of some isolated compounds from *Bombax malabaricum*: **A)** Compound 1 was elucidated as 5-isopropyl-3-methyl-2,4,7-trimethoxy-8,1-napthalene carbolactone; Compound 2 was identified as 8-formyl-7-hydroxy-5-isopropyl-2-methoxy-3-methyl-1,4-naphthoquinone (Source: Reddy et al., 2003); **B)** Compounds 1–4 are bombamalones, 5 is bombamaloside, 6 is isohemigossypol-1-methyl ester, 7 is 2-*O*-methylisohemigossylic acid lactone, 8 is bombaxquinone B and 9 is lacinilene C (Source: Zhang et al., 2007); **C)** Compound is 7-hydroxy-5-isopropyl-2-methoxy-3-methyl-1, 4-naphthoquinone (Source: Sreeramulu et al., 2001) and; **D)** Compound 1 is bombasin, 2 is bombasin 4-*O*-$\beta$-glucoside and 3 is bombalin (Source: Wu et al., 2008).

The focus of the studies was isolation and characterization of these compounds and so they did not undertake the study of their antioxidant activities. However, the study of the antimicrobial activities of some of the compounds was undertaken and they were found to be effective while the cytotoxicity tests undertaken by Zhang and co-workers indicated inactivity (Zhang et al., 2007). In addition, Wu and co-workers isolated three compounds (Fig. 2) from the flowers of *B. malabaricum* which were called bombasin, bombasin 4-O-b-glucoside and bombalin (Wu et al., 2008). Shahat and co-workers isolated and identified mangiferin from the dried leaves (Shahat et al., 2004). Moreover, their study refuted the otherwise isolated compound by Faizi and Ali (1999) was shamimin and insisted that based on their findings the compound was actually mangiferin requesting that Faizi and Ali revise their structure. This compound was shown to exhibit hypotensive and hypoglycemic activities in Sprague–Dawley rats by Faizi's group (Saleem et al., 1999). The toxicity studies show non-toxicity at a high dose of 1 g/kg in mice but 500 mg/kg was a lethal dose in rats (Saleem et al., 1999). In addition, this group isolated a compound, shamimicin from the stem bark and explored extracts from other parts of the plant for hypotensive activity along with lupeol (Saleem et al., 2003). While shamimicin did not exhibit significant hypotensive activity, lupeol and the extracts especially those from the flowers and pulp were found to be significantly hypotensive. A naphthaquinone (Fig. 2) was isolated for the heartwood and characterized as 7-hydroxy-5-isopropyl-2-methoxy-3-methyl-1,4-naphthoquinone (Sreeramulu et al., 2001). Fig. 3 shows a flow chart summarizing the extraction process undertaken to obtain active ingredients from *Bombax* species.

## Future research

Despite the controversy of free radical theory of ageing, ageing of the skin (a classical example) has been slowed down by use of antioxidants which explains the incorporation of antioxidants in anti-ageing creams. These creams have been proven to minimize fine lines and wrinkles as well as improve elasticity of the skin (Heinrich et al., 2006; Segger and Schönlau, 2004; Udompataikul et al., 2009). This may be extrapolated to suggest that body ageing can be slowed down and managed with the use of anti-oxidants. Based on the studies done so far on *B. buonopozense* and *B. malabaricum* especially, they hold promise in age-management — the prevention, perhaps reverse and delay of the onset of age-related diseases. However, more studies need to be undertaken before they are commercialized as nutraceuticals.

The oxygen radical absorbance capacity (ORAC) of all active compounds should be determined. Are the antioxidants also pro-oxidants? If so, do their antioxidant effects dominate their oxidative effects or vice versa?

Not all the compounds from the different parts of the plant has been isolated, identified and characterized. The characterization of these compounds exerting antioxidant activities should be undertaken. Can the isolated compounds be combined? Will there be any

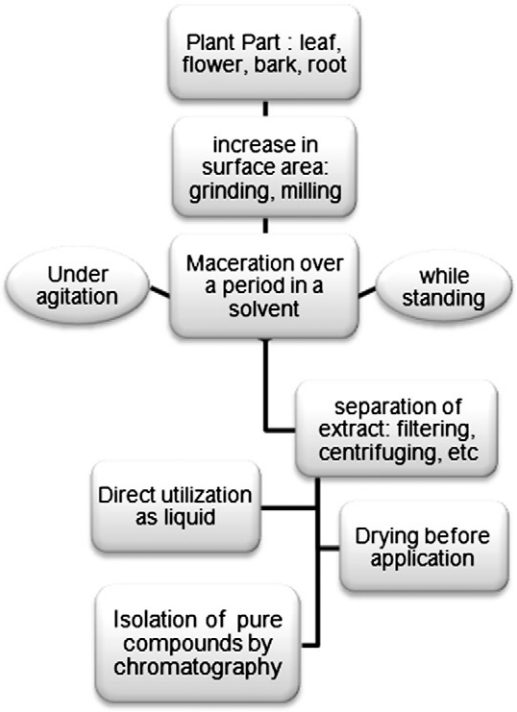


**Fig. 3.** A flow chart outlining the extraction process undertaken to produce active ingredients from *Bombax* species.

interactions? These compounds should be studied individually and in combination for potential efficacies and mechanisms of actions. For instance, mangiferin exhibited free radical scavenging nature but could not protect against deoxyribose damage or lipid peroxidation (Dar et al., 2005). So if the different compounds are combined, will there be synergy, additivity, indifference or antagonism? The optimal dose required for each compound and in combination should be studied and ascertained. Then these antioxidants should be formulated for convenient delivery. Furthermore, attempts should be to target these antioxidants to specific sites for direct and optimal actions. Pharmacokinetic studies should also be undertaken in order to know the bioavailability, degree of metabolism and elimination.

Plant phenolic compounds have affinity for proteins and the interaction form soluble or insoluble complexes which may affect the activities of both (Naczk et al., 2011). Hence studies should be undertaken to determine if the phenolic compounds from *B. buonopozense* and *B. malabaricum* interact with proteins. If they do, can these compounds be modified so as not to be able to bind to proteins and in addition not lose their ability to scavenge free radicals?

Finally, double-blind placebo-controlled studies should be undertaken in order to explore the degree of the influence of antioxidants from *B. buonopozense* and *B. malabaricum* in age-management — in the prevention, reversal and delay of onset of age-related diseases.

## Conclusion

Based on studies so far undertaken, the two plants from family *Bombaceace* have capacity to prevent, treat and manage quite a number of diseases and this ability has been attributed to its antioxidant activities. Studies have also shown that they exhibit no or low toxicity. Consequently, *B. buonopozense* and *B. malabaricum* can be explored as nutraceuticals for age-management.

**Conflict of interest statement**
The author declares there is no conflict of interest.

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