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ANTI-OXIDATIVE POTENTIALS FROM SIX THAI COMMON MEDICINAL AND EDIBLE PLANTS

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Abstract: Repetitive and long term exposure of solar UV irradiation can cause skin aging and induced wrinkling skin. These remarkable sequences are involving in accumulation of reactive oxygemspecies (ROS), induction of pro-inflammatory cytokines, and degradation of skin extreacellular matrix (ECM). Moreover, repetitive photo-aging by solar UV damaged together with chronological aging could cause significant changes in skin morphology. As the cosmetic market increasing, the high demands usage of synthetic anti-oxidative compounds consequently exhibited long term adverse effects to consumers. Thus, the attempt to find a natural plant extracts with anti-oxidative power can be used as a good candidate for anti-aging formulation. The present of this review mainly aimed to provide alternative plants information as a candidate to use their reported active ingredients, which exhibited possible potential on skin aging prevention. The review on these medicinal and edible plants with their constituents was described to highlight the potentials of the plants which may help to maximize the beneficial of anti-skin aging therapy.

Key words: Skin aging, photo-aging, wrinkling skin, photochemical compounds.

Introduction

Aging refers to a remarkable complex event decreasing in health function and esthetic change of multiple organ systems that leads to increase mortality from stresses and diseases (1, 2). Moreover, the impact of aging on the function and appearance particular in the skin is recently growing interests. Among skin aging factors (both intrinsic and extrinsic), repetitive sunlight exposure has been considered to be the most possible factor that could cause skin aging (3). However, the precise physiological and biological mechanisms remain to be elucidated. Skin aging caused by UV exposure (photoaging) is superimposed on chronological skin aging. Photoaging and chronological skin aging showed various distinct entities in histology (4). Previous study reported that repetitive UV-exposure could cause skin aging and leaded to the accumulation of peroxyl free radicals, which caused from broken down of malondialdehyde (MDA) subsequently cross-links and polymerizes collagen. These events caused further decrased in skin elasticity water holding capacity in the skin, which a common and obvious symptom of photo-aged wrinkling skin (5). Thus, one of many pathways to prevent the aging effect on skin is due to scavenge the free radical formation in the skin by using anti-oxidative agents.

From the past, there are many cosmetic products that used chemical synthetic compounds that contained active ingredients including monoethanolamine, diethanolamine, sodium laureth sulfate, triethanolamine, etc, which may cause adverse effects such as skin allergy, contact dermaltitis, irritation, and photo-sensitive skin. Moreover, antioxidants such as vitamins A and E, squalene, co-enzyme Q10, ferulic acid, idebenone, pycnogenol and silymarin are being used in skin care products, which promoted skin repair from environmental damage to the skin (6). However, the cost of their pure compound is expensive. Because of this situation, the demands of skincare products that used natural plant extracts as anti-oxidative ingredients are growing interests. Searching a good candidate plant to find its active ingredient becomes challenge. Many medicinal plants and herbs, especially in the part of fruits, grains, and leaves are riches in anti-oxidant compounds that can scavenge free radicals, one of the reasons that can induce skin aging. In present, cosmetics produced from natural ingredients are now growing popular all over the world according to their significant positive effects on skin aging. This review article aimed to provide alternative plants information as a candidate

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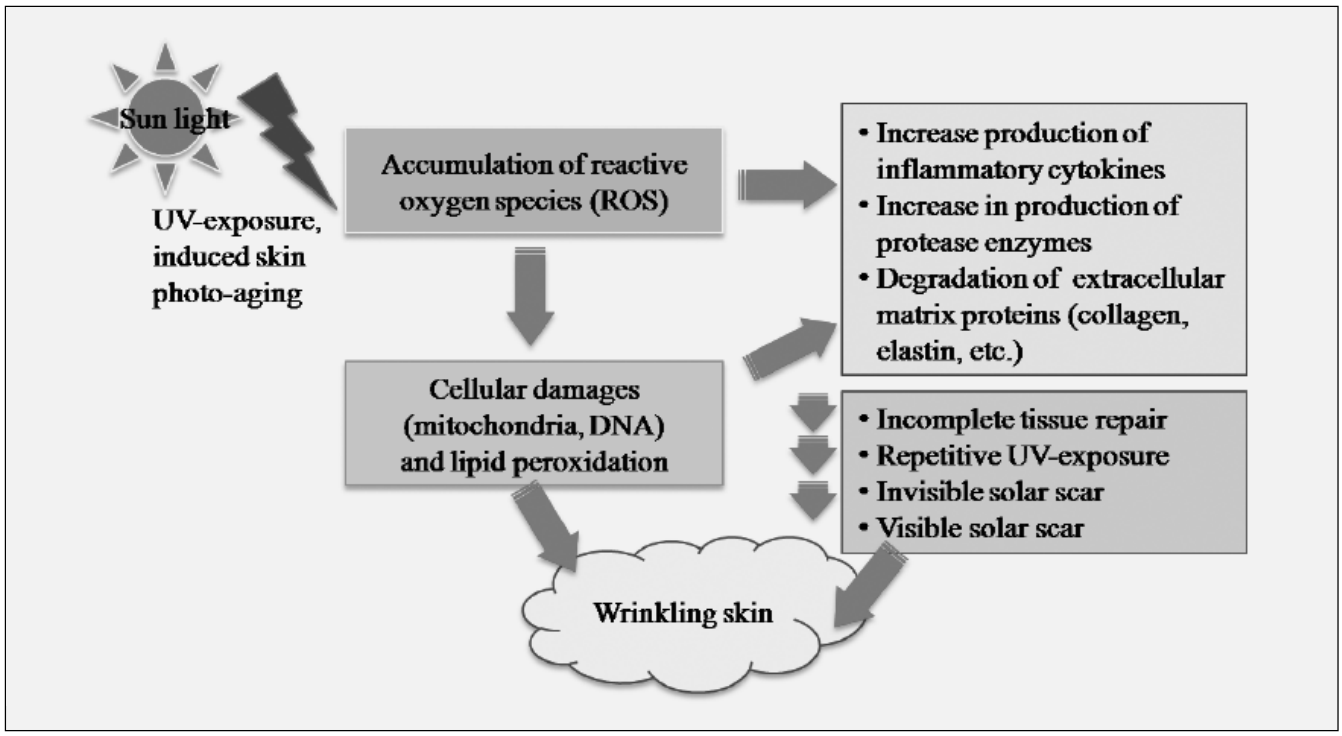
Figure 1
Possible pathway of premature UV-induced skin aging



to use their reported active ingredients in order to have some potential on skin aging prevention. The review on these plants and their constituents were described to highlight the potentials of the plants useful in skin aging from natural resources.

Plant extracts served as alternative anti-oxidative agents

Psidium guajava Linn

Psidium guajava Linn. (family Myrtaceae) has been that they are riches in flavonoids and phenolic compounds in leaves (16-18). The total phenolic content in the extract was deter- mined spectrophotometrically according to Folin–Ciocalteu's phenol method and calculated as gallic acid equivalent (GAE). By using hot water extraction methods, dried leaves crude extracts exhibited remarkably high total phenolic content 575.3 ± 15.5 were obtained (19). Moreover, the antioxidant activity of lyophilized leaf extracts was determined using free radical DPPH (2,2-diphenyl-1-picrylhydryzyl) scavenging. It was showed that the leaves extracts of Psidium guajava Linn. exhibited similar trends of scavenging DPPH radical as ascorbic acid. Thus, it was concluded that the ability were from there phenolic contents such as protocatechuic acid, ferulic acid, quercetin and guavin B (7), quercetin, ascorbic acid, gallic acid and caffeic acid (20). Guava leaf extracts are a potential source of natural antioxidants (21).

Piper betel L.

Previous studies found active ingredients called allylpyrocatechol and chavibetol, which isolated from Piper betel L. leave extracts (22). However, allylpyrocatechol was found to be more potent. In addition, both active compounds exhibited protection of photosensitization-mediated lipid peroxidation of rat liver mitochondria (22). Moreover, Piper betel L. leave extracts showed a positive effect to prevent Cd induced oxidative hepatic dysfunction in rats. Prabu et al. concluded that the results may cause from allylpyrocatechol, which found in Piper betel L leaf (23). By using GC and GC-MS analysis. Prakash et al. revealed that there were 32 different components, which constitute 97% of the oil (8). In their investigation, eugenol (63.39%) and its ester derivative acetyleugenol (14.05%) were recorded as major components of oil. They also found that the anti-oxidative activity of the P. betle essential oil was found to be concentration dependent and very close to ascorbic acid, which implied that it can an alternative source for anti-oxidative agent to synthetic anti-oxidants. These discoveries suggested that allylpyrocatechol and eugenol have an important role in protecting biological systems against cellular oxidative damage.

Table 1
List of six common Thai medicinal/edible plants and their functions

No.	Plant species	Part used	Active ingredients	Possible function	References
1.	Psidium guajava Linn.	Leaves	Phenolic compunds, ferulic acids	Anti-oxidant and free radical scavenging capacity	(7)
2.	Piper betel L.	Leaves	Eugenol, allylpyrocatechol,and chavibetol	Anti-oxidant, anti-fungal, aflatoxin suppressive	(8)
3.	Schefflera leucantha R. Viguier	Leaves	Saponins	Anti-tyrosinase activity, anti-microbial activity	(9)
4.	Andrographis paniculata Nees	Leaves	Andrographolide, echiodinin	Anti-bacterial and anti-oxidant activity	(10)
5.	Garcinia mangostana Linn	Peel	α-mangostin	Anti-oxidant, Anti-tumor, Anti-inflammatory	(11-13)
6.	Oryza sativa L.	Grains	γ-oryzanol	Anti-oxidant, promote tissue remodeling	(14, 15)

Schefflera leucantha R. Viguier

Schefflera leucantha R. Viguier, (Araliaceae), was found locally in Thailand and known as 'Hanuman Prasankai'. Prevoius reported indicatied that Schefflera leucantha R. Viguier crude extracts exhibited saponins (24). This phytochemical active compound showed an anti-oxidative activity similar to ascorbic acid on DPPH radical scavenging assay (9). Moreover, an aqueous Schefflera leucantha R. Viguier leave extracts were described as hypoglycemic activity in rats and anti-fungal activity (9, 25). From these study, it was concluded that the leaves of S. leucantha had benefit for extracting its crude oil to develop as an anti-oxidants.

Andrographis paniculata Nees

Andrographis paniculata Nees (A. paniculata) is commonly known as Creat or King of bitters due to its bitter taste, and it was often called as Fah Tah Lai in Thailand. From the past, crude aqueous extract of A. paniculata has long been used to treat diarrhoea with overall effectiveness of 91.3% (26). Rafat et al. reported that the crude extracts of A. paniculata exhibited anti-oxidant activity due to it contained phenolic compounds (27). Furthermore, in 2011, Wasman et al. concluded that the ethanol extract exhibited more phenolic content and presented stronger activity than aqueous extract (28). Moreover, it was found that the high phenolic contents were identified as andrographolide (AND) and echiodinin (ECH), which exhibited postitive scavenging result on DPPH assay when compared with ascorbic acid (10). Moreover, from Arifullah et al. study, the andrographolide (AND) and echiodinin (ECH) purified from A. paniculata crude extracts by using thin layer chromatography methods showed anti-bacterial activity in both gram postitive and gram negative bateria including avirulent Mycobacterium smegmatis (10). However, they also found that the anti-oxidative activity from purified echiodinin (ECH) showed higher activity in as compared to purified andrographolide (AND). Thus, the higher anti-oxidant activity in purified echiodinin (ECH) may cause from their number and position of free hydroxyl group attached to phenol rings that can readily donates the phenolic hydrogens or electron to the acceptor molecules (29).

Garcinia mangostana Linn

Garcinia mangostana Linn or commonly known as mangosteen is one of edible fruit in Thailand. The fruit of mangosteen is dark purple or reddish peel, with internal white, soft and juicy edible pulp. The pulp contained a slightly acid, sweet flavor, and a pleasant aroma (30). Interestingly, Xanthones or xanthen-9H-ones are secondary metabolites that found most in Garcinia mangostana Linn. An α-mangostin, as known as active compound was firstly xanthone isolated in Garcinia mangostana Linn. pericarp (31) and later were ♌-mangostin (32) and γ-mangostin (33). Moreover, xanthones derivative compounds also found in many parts of the G. mangostana such as fruit, bark, and leaves (34). In the study of anti-oxidant activity of extracts and xanthones isolated from Garcinia mangostana Linn by using DPPH assay revealed that ♋-mangostin exhibited an ability to scarvenage DPPH readical (11). Moreover, ♋-mangostin was found to reduce human low density lipoproteins (LDL) oxidation induced by copper or peroxyl radical (35), prevented the decrease of the ♋-tocopherol consumption induced by LDL oxidation (36), induced apoptosis in human leukemia cell lines (37), and exhibited anti-tumoral activity against DLD-1 cells (38). These findings indicated that usage of the anti-oxidant properties of extracts from Garcinia mangostana Linn.

Oryza sativa L.

Rice (Oryza sativa L.) is one of the most important edible crops in Thailand. From the past, many studies have reported several active ingredients from rice, e.g. gamma-oryzanol (γ-oryzanol) (39), tocopherols, and tocotrienols (40). In addition, rice bran is a potential source of various discovered active compounds (41). Gamma-oryzanol is a complex mixture of ferurate esterfied with sterols or triterpene alcohols (42) and was purposed to be the major anti-oxidant compound found in rice bran (43). Moreover, crude rice oil extracted from rice grain had been used to study anti-oxidative property by using DPPH assay and HPLD analysis. Butsat and Siriamornpun showed that Oryza sativa L. Thai rice called Khao Dawk Mali 105 exhibited anti-oxidative property and showed high contents of γ-oryzanol and tocopherols found in barn (44). They also found three major phenolic acids, which were ferulic acid (found most evident in the bran), vanillic, and p-coumaric acids (found mostly in the husk). Another types of rice is coloured rice, particularly black rice (Oryza sativa L. indica), which contained natural anthocyanin compounds, such as cyanidin 3-glucoside and peonidin 3-glucoside, which exhibited anti-oxidative activities (45). Together with γ-oryzanol, the black rice crude extracts showed a reduction of reactive oxygen species (ROS) such as lipid peroxide and superoxide anion radicals and reduced cholesterol content in hypercholesterolemic rats (46, 47).

Recently, our original studies have been conducted to study the anti-oxidative activity in crude rice extracts as an attempt to find an alternative way to utilize cadmium-contaminated rice without introducing health hazard risks. From the past, it was discovered in Thailand that there is a cadmium contamination occurred in rice and soil in Mae Sot District, Tak Province (48). However, biotic and abiotic stress, such as cadmium stress, induced plant to product secondary metabolite products as defense mechanisms against the stress (49). Our studies showed that crude rice oil extracted from cadmium-contaminated rice exhibited anti-oxidative property as determined by using DPPH assay (15). We also found that the main active compound found in crude cadmium-contaminated rice oil was a γ-oryzanol as determined by using RP-HPLC. It was found that the γ-oryzanol content in crude rice oil extracted from cadmium-contaminated rice was higher than control crude rice oil. Thus, it was implied that higher anti-oxidative compound found in crude cadmium-contaminated rice oil may cause from the defense mechanisms of secondary metabolites production in rice in different levels both biotic and abiotic stress. Moreover, the crude rice oil extracted from cadmium-contaminated rice contained very low level of cadmium concentration, which considered safe for consumption (15). We also determined the anti-oxidative activity of crude rice oil in an in vitro primary human skin fibroblast cell model. The results showed that crude rice oil extracted from cadmium-contaminated rice reduced oxidative damage on cellular mitochondrial activity, exhibited down-regulation of SIRT1 mRNA, and up-regulation of MMP-2 in PHF cells in vitro, which may promote tissue remodeling (14). Our studies showed significant information of crude rice oil extracted from cadmium-contaminated rice, which exhibited the potential of anti-oxidative activity and can be utilized without compromising human health with hazard risks.

Conclusion

The information of this review provided a significant scientific validity on usage of medicinal and edible plant extracts as an anti-oxidiative agent, which should be investigated further based on different models. Moreover, from previous studies, it was amazingly that these reviewed plants also showed another effects such as anti-inflammatory, anti-fungal, anti-cancer effects, etc. However, there are lots of experiments need to be studied in depth. It is still very clear that all these reviewed plants are goods promising candidates for serving as therapeutic substances or cosmeceutical potential in the future. Nevertheless, further studies need to be done in order to investigate the effects of these plants extracts in animal models in vivo and/or in human.

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