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Ethno-botanical and Pharmaceutical Properties of Mollucan Spinach (*Gynura procumbens* Lour. Merr)

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ABSTRACT: Recently there has been increase in patronage of herbal medicine due to economic constrain particularly among low income earners in the developing countries such as Nigeria. *Gynura procumbens*, (Molucan spinach) is widely used in traditional medicine for treatment of wide ailments such as fever, malaria, anti-glycaemic, rheumatism, hypertension, diabetes mellitus, cancer, kidney diseases, anti-inflammatory, constipation, male sterility and body pain among others. This study reviews the ethnobotanical and pharmaceutical properties of *G. procumbens* (Lour.) Merr hence provided some data and information on the biological activity of *G. procumbens* which evaluated and validated its efficacy and safety in the treatment of different ailments. Based on the traditional uses of *G. procumbens*, the specie appears to possess high therapeutic potential for treatment of various diseases hence making it a target for pharmacological studies. Despite the knowledge and use of ethnomedicine the current scientific evidence on biological activities of *G. procumbens* remain scanty.

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The use of traditional herbal base medicines was widely acknowledged and established for their efficacy and safety. Concern grows on importance of medicinal plants due to their potential pharmacological benefit. Recently, World Health Organization (WHO) estimated about 80% of people globally rely on herbal medicine for treatment of many ailments for some part of their primary health care, income generation and livelihood (Rehman et al., 2016). Today, increase in demands of herbal therapies perhaps was created based on the positive past experience of the effectiveness of these herbal medicines, however advancement and innovative development in herbal study play a major role in validation of medicinal herbs. Currently herbal medicine product market is experiencing rapid growth due to integration of orthodox medicine and herbal therapy practice by health professionals. The international market of herbal medicine is estimated to be $62 billion and will greatly rise up to $5 trillion by the year 2050 (WHO, 2002). Nigeria is reported to have about 7,895 herbal species which are useful for medicinal value and health properties, and could make morethan $19.4 billion annually from developing products from herbal medicine (Olubunmi et al., 2022). However many of these herbal plants remain unexplored. The plant has been traditionally consumed for treatment of different ailments such as kidney stone, hypertension, inflammation, cancer and diabetes (Hew et al., 2013), anti-inflammatory, anti-hyperglycemic and analgesic (Roshida et al., 2008). Many plant species have ethno medicinal importance and used extensively for treatment of different ailments (Ahmed et al., 2018). In the case of *G. procumbens*, leaf is the main plant part used commercially. Reports had also shown that

organically grown herbs are higher in total phenolics, carotenoids, vitamins and antioxidants as compared to conventional methods (Riahi et al., 2009; Ibrahim et al., 2013).

Description and geographical distribution: Gynura procumbens is a small plant less than 1 to 3 m in height with a fleshy erect stem, semi-succulent leaves are lanceolate 3.5 to 8 cm long and 0.8 to 3.5 cm wide, flowering heads 20 – 35 panicle, yellow or orange-red or purple 9 – 20 mm long narrow, exerted part 2 -3.5 mm long, flowering and fruiting throughout the year (Burkill, 1985; Ongkarn, 2009). The highest diversity of these plants had been reported in Southeast Asia (Davies, 1980) the specie *G. procumbens* is indigenous to Malaysia, Indonesia and Thailand (Keng et al., 2009) but it is widely distributed to Philippines, India, China, Sri Lanka, Thailand, Singapore, Sierra Leone, Nigeria and Bangladesh. Interestingly, it was introduced to Bangladesh via a social worker to treat diabetic for his friend's father and it's widely used as a treatment for diabetic in Bangladesh (Rahman and Al-Asad, 2013) and probably into Nigeria from South East Asia via Sierra Leone (Burkill, 1985).

Gynura procumbens: Gynura procumbens (Figure 1) is a member of the Asteraceae family which comprises of 44 species and is distributed from tropical South and East Asia to Africa and one specie in Australia (Vanijajiva and Kadereit, 2011). It is one of the most interesting plants from health perspective and widely used in South East Asia for medicinal purposes in ethnomedicine (Akowuah et al., 2002). Common name includes Longevity spinach, Cholestrol spinach, Green Harmony, Leaf of God. In Nigeria It is locally called "Eburè" and "ṇtị-ènē" in Yoruba and Igbo dialects, "SambungNyawa" (Malay), ai Bing Cao" (Chinese) (Tan, et al., 2016), "DaunDewa" in Indonesia, and "Paetumpung" in Thailand (Burkill, 1985).

Fig 1: Image of *Gynura procumbens. https://lorenzogourmet.weebly.com/gynura-ashitaba.html*

The plant *G. procumbens* is utilized in traditional medicine for topical application in the treatment of different types of ailments (Krishnan et al., 2015). It is commonly used in treating rash, eruptive-fever, kidney disease, hypertension, migraine, diabetes mellitus, constipation and cancer (Roshida et al., 2009; Algariri et al., 2013; Timotius and Rahayu, 2020). Bioactive compounds such as flavonoids and glycosides were credited to be the active phytochemicals of the specie (Akowuah et al., 2002). *Gynura procumbens*, has received a particular attention in the pharmacology as an antidiabetic medicinal plants. The small molecular weight compounds extracted from *G. procumbens* have been reported to display anti-cancer, antioxidant, anti-inflammatory and anti-hyperglycemic activities. The benefits of the traditional use of *G. procumbens* have also been supported by the identification of several active chemical constituents including flavonoids (kaempferol, rutin and quercetin), chlorogenic acids, phenolics and steroids (Timotius and Rahayu, 2020). *Gynura procumbens* is a new source of potential herbs in the herbal industry. Leaves of *G. procumbens* was reported to have anti-herpes simplex virus (Nawawi et al., 1999), anti-hyperglycemic (Akowuah et al., 2002), anti-inflammatory (Iskander et al., 2002), anti-hyperlipidemic (Zhang, 2000), anti-allergy agent and anti-hypertensive properties (Kim et al., 2006).

Planting: Requirements such as soil fertility, quantity of nutrients in correct proportion and cultivation practice are essential to achieve optimum yield. Besides fertilization, yield is found to be influenced by the planting distance. Abirami et al. (2014) has observed huge influence of planting distance on growth, development and yield of crops. Maximum yield could be obtained if the plant community produces enough leaf area to provide maximum light interception during their growth and minimize interplant competition (Egli, 1988). Crop yield has been reported to be increased with higher planting distance. This positive effect was attributed to less weed growth and greater covering of soil (Francis et al., 1990). Optimum distance between rows will also help to ensure enough water supplies to the plants (Carruba and Calabrese, 2002). Wider spacing produced greater number of leaves and higher shoot yield per plant of *Moringa oleifera* than the medium and close spacing (Amaglo et al., 2006). For rose-scented geranium, closer harvesting intervals produced less herbage yield and oil yield while longer harvesting intervals produced more herbage and oil yield (Nozipho, 2006). Multiple harvests are normally practiced on most semi-perennial and perennial herbal crops. However, reduction in biomass (Murtagh, 1996; Weiss, 1997) and phytochemical composition due to

repeated harvest has been reported (Rita et al., 2013). Kothari et al. (2004) stated that biomass yield was greater in the first harvest and gradually declined in subsequent harvests. Hence considerable time is needed before harvesting the first crop so that it could establish itself, thereafter, for subsequent harvests to avoid losses in yield and quality (Alizadeh et al., 2010). For *G. procumbens,* multiple harvesting is done by removing their fleshy stem and branches. However, it is not clear when the herbage should be harvested or the stage at which it can produce the highest yield and phytochemical content. Due to uncertainty of the effect of multiple harvests, there is need to carried out study to determine the ideal harvesting time and frequency for *G. procumbens* production.

Medicinal Properties: Many vegetables and herbs serve as good source of vital micronutrients, vitamins and mineral elements, raw material such as fibre, fruit juice, fat and oil, beverages, pharmaceutical importance as well as source of income to family. The benefits of the traditional use of *G. procumbens* have also been supported by the identification of several possible active chemical constituents (Table 1).

Anti-hypertensive and cardio protective activity: Lu et al. (2012) stated that hypertension is a key risk factor for several cardiovascular diseases including coronary vascular disease and stroke. Hoe et al. (2011) has reported *G. procumbens* resulted in significant lowering of systolic blood pressure and mean arterial pressure in hypertensive rats. Extract of *G. procumbens* has also resulted in significant decrease in heart rate, strong negative chronotropic, and negative ionotropic effects at rats' right atrium and left atrium (Abrika et al., 2013). The blood pressure-lowering effect of *G. procumbens* was associated with its inhibitory effect on angiotensin-converting enzyme activity. Inhibition of influx of extracellular Ca^{2+} could also be associated with vasodilatory effect of *G. procumbens.* Ng et al. (2013) suggested *G. procumbens* potentially serves as an antihypertensive agent with cardio protective activity due to its ability to target various mechanisms including the renin-angiotensin system and calcium influx which are crucial players in the pathophysiology of hypertensive conditions.

Anti-hyperglycemic activity: Diabetic patients are commonly treated with *G. procumbens* in traditional medicine for its hypoglycemic effect (Algariri et al., 2014), and specificity to induce hypoglycemic effect only in diabetic animals causing significant decrease in fasting blood glucose levels and suppression of glucose elevation during glucose tolerance test in diabetic rats but not in control group rats (Zhang and Tan, 2000; Algariri et al., 2013). With reference to metabolic pathways, *G. procumbens* was found to exert an effect on glucose metabolism in liver. It was demonstrated to cause phosphorylation and inactivation of glycogen synthase kinase 3 (GSK3) in the liver of diabetic rats, suggesting that the hypoglycemic action of *G. procumbens* is due to either direct or indirect effects on the upstream component(s) activities in the insulin signaling pathway (Gansau et al., 2012). In addition, it stimulated an increase in activity of glucokinase and pyruvate dehydrogenase and phosphorylation of ATP-citrate which are known to play roles in glucose metabolism (Kang et al., 2015). This indicates *G. procumbens* stimulated an increase in utilization of hepatic glucose and decreased endogenous glucose production (Lee et al., 2012).

Table 1. Bioactivity of compounds from leaf extract of *G. procumbens*

Extract	Bioactive compound	Activity
Aqueous	Chlorogenic acid dimer	Antioxidant activity, hypoglycemic, hepto protective
Essential oil	Alpha-pinene,3-carene, limonene	Anti-inflammatory, anti-nociceptive effects, hepatoprotective effect
Methanol, Ethyl acetate, Butanol	Kaempferol-3-orutinoside, astragalin, steroids	Anticancer, hepatoprotective, inflammation, Rheumatism, Antivirus
Ethanol	Caffeoylquinic rich, chlorogenic acid, Quercetin	Antioxidant, antihyper-lipidaemia, hypoglycemia
Ethanol fraction with ethyl acetate, n-butane fraction	p-caumaric acid, kaempferol, kaempferol-3-O-glucoside, kaemp-ferol-3-O-rhamnosyl(1→2) galactoside, quercetin 3-Orhanosyl (1→6) glucoside	
Ethyl acetate	Cynarine, isochlorogenic acids A, Isochlorogenic acids C	Antioxidant, anti-inflammatory,
Ethanol fraction, active protein fraction	Miraculin, thaumatin-like proteins, Glycoconjugated or peptidal substance	Antioxidant, anticancer, hypotensive effect

Source: Timotius and Rahayu (2020)

There has also been work examining the hypoglycemic effect of *G. procumbens* in combination with other herbal therapies. It was observed to achieve a stronger hypoglycemic effect when *G. procumbens* was used together

with *Azadirachta indica* or *Andrographis paniculata* (Pramono and Nugroho, 2015). The synergistic effect is postulated to be related to the diverse range of active compounds present in the extract combination (Sunarwidhi et al., 2014). Taken altogether, the current evidence suggests the presence of bioactive principles which possess insulin mimetic properties in *G. procumbens* (Hassan et al., 2010). The effect of *G. procumbens* treatment on insulin level has been investigated. Hamid et al. (2011) has reported the stimulation of insulin secreting cell lines by *G. procumbens* extract. However, the exposure of clonal pancreatic cells with extract of *G. procumbens* did not stimulate insulin secretion (Hassan et al., 2008). These contradicting results might be due to the differing response of different cell lines when treated with *G. procumbens.* Therefore, its effect on insulin secretion has been further tested using *in-vivo* studies. However, no significant change has been observed in plasma insulin level in diabetic rats treated with the extracts, implying that the hypoglycemic activity of *G. procumbens* does not rely on insulinotropic activity but may instead be due to its extra-pancreatic effect (Hassan et al., 2008; Lee et al., 2012).

Sexual and reproductive function enhancement activity: Many research works on *G. procumbens* has also explored its potential in treating infertility, which is one of the complications of diabetes (Ramalho-Santos et al., 2008). *Gynura procumbens* showed an effect on sexual and reproductive function with significant increased sperm count, sperm motility, and reduced the percentage of sperm mortality of diabetic rats (Sani et al., 2008). Its aphrodisiac properties were also demonstrated as evidenced by an increase in mounting frequency of diabetic rats (Noor and Radzuan, 2012). In term of enzymatic activity, *G. procumbens* was found to promote testicular lactate dehydrogenase activity (Hakim et al., 2008). This finding can be correlated to improved fertility because lactate dehydrogenase is known to play a crucial role in spermatogenesis (Kaur and Bansal, 2004). Overall, studies clearly suggest that *G. procumbens* may improve the reproductive function of infertile diabetic males, particularly through an increase in sperm counts, quality, and motility.

Anticancer activity: Gynura procumbens inhibits the initiation phase of carcinogenesis. The treatment with ethanolic extract caused a significant reduction in expression and activity of cytochrome P-450 enzymes such as CYP3A4, CYP1A2, and CYP1A1 (Afandi et al., 2014; Ghofur et al., 2015). In addition, *G. procumbens* treatment has also been shown to stimulate expression of glutathione-transferase which is involved in the detoxification of carcinogenic compounds. These activities help to prevent cancer formation at its initiation phase (Hamid et al., 2009; Ghofur et al., 2015). Cancer patients frequently consume herbal medicine as complementary and alternative medicine while undergoing chemotherapy (Cheng et al., 2010). In view of this, co-treatment studies of *G. procumbens* and chemotherapy drugs have been carried out. The combination of *G. procumbens* extract with doxorubicin or 5-fluorouracil resulted in strong synergistic effect against breast and colon cancer cells (Meiyanto et al., 2007; Nurulita et al., 2011, 2012). However, co-treatment of *G. procumbens* with cisplatin appeared to be antagonistic as this combination failed to further suppress cancer cell proliferation (Nurulita et al., 2011). This demonstrates that the concomitant use of *G. procumbens* with different chemotherapy drugs might result in variable treatment efficacy. *Gynura procumbens* has long been used as traditional treatment for cancers such as leukemia, uterine, and breast cancers (Agustina et al., 2006). This has prompted scientific exploration of the antitumor activity of *G. procumbens* (Maw et al., 2011). Short term (10 weeks) treatment of the ethanolic extract was found to suppress the progression of nitroquinoline 1-oxide-induced tongue carcinogenesis during initiation phase. Longer period (26 weeks) of administration was demonstrated to lead to high suppression of oral carcinogenesis (Agustina et al., 2006). The ethanolic extract was also shown to be effective against carcinogenetic effect of 7,12-dimethylbenz (a) antracene on liver (Nisa et al., 2012). *Gynura procumbens* has been also tested on osteosarcoma cell line. The treatment has resulted in inhibition of cell proliferation and was observed to suppress the invasive and migratory abilities of the cancer cells (Wang et al., 2013). Recently, ethanolic extract of *G. procumbens* was shown to cause about 80 % decrease in azoxymethane-induced aberrant crypt foci in rats which indicates potential in preventing colon cancer (Shwter et al., 2014). Therefore, *G. procumbens* appears to be an effective chemotherapeutic agent against a wide range of cancer cell types and it exerts its anticancer activities via the modulation of various points of carcinogenesis including cancer initiation, cell proliferation, metastasis, and angiogenesis.

Antimicrobial activity: The increasing incidence of resistant strains of malaria, viruses and also bacteria to currently available drugs makes the search for alternative therapeutics from herbal plants a key area of interest (Tan et al., 2015). The antiplasmodial activity of *G. procumbens* was first reported by Vejanan et al. (2012). The research shows that *G.*

procumbens extract exhibits chemo-suppression effects toward malarial parasite strains of *Plasmodium falciparum* 3D7 and *P. berghei* NK65; possibly via direct inhibition of GSK3 or indirect action on pi3K/Akt pathway. Besides, the ethanolic extract of aerial plant parts has been demonstrated to exhibit virucidal and antireplicative activity against herpes simplex virus HSV-1 and HSV-2. (Jarikasem et al., 2013). Meanwhile, the antibacterial activities of *G. procumbens* have also been tested with the extract exhibiting antibacterial activity against gram-positive and gram-negative bacteria such as *Bacillus cereus*, *Pseudomonas aeruginosa*, *Vibrio parahaemolyticus*, and *Salmonella typhi* (Rahman and Asad, 2013; Zheng et al., 2014). The antifungal activity of *G. procumbens* against fungi such as *Candida albicans* and *Aspergillus niger* was also observed. The findings of these studies have provided supporting evidence that substantiate the traditional use of *G. procumbens* in the treatment of infections by pathogens such as herpes simplex virus and malaria parasites (Kaewseejan et al., 2012; Nasir et al., 2015).

Organ protective effect: The protective effect of *G. procumbens* against damage of body tissues and organs has also been evaluated. *G. procumbens* was found to exert a gastroprotective effect as the administration of ethanolic extract significantly lessened the areas of ethanol-induced gastric ulcer in rats; with a reduction of submucosal edema and infiltration of leucocytes was observed (Mahmood et al., 2010). This finding has intrigued the researchers to further explore the protective effect of *G. procumbens.* In a study on skin damage, the anti-photoaging property of *G. procumbens* has been discovered as it was found to cause a significant inhibition in the expression of matrix metalloproteinases induced by ultraviolet irradiation in human dermal fibro-flasts (Kim et al., 2011). The results obtained in both studies demonstrated that its protective effects might be associated with the Reactive oxygen species scavenging activity of *G. procumbens* (Mahmood et al., 2010; Kim et al., 2011). *Gynura procumbens* is also known to be effective in preventing progressive renal diseases. The aqueous extract of plant was found to cause inhibition of mesangial cell proliferation and DNA synthesis. The suppression of regulator proteins for cell proliferation was found to be responsible for this observed effect (Lee et al., 2007). In addition, *G. procumbens* was found to have a hepatoprotective effect as it was shown to attenuate the ethanol-induced lipid accumulation in mice livers by modulating lipid metabolism-related genes, particularly via MAPK/SREBP-1c-dependent and -independent pathways (Li et al., 2015). Based on these findings, *G. procumbens* has significant potential as an organoprotective agent; mainly due to its antioxidative properties which exert a regulatory effect at the level of gene expression.

Mineral Elements: Many medicinal plants have been reported to contain different element constituents and it is considerable to quantify elements contents of ethno botanical plant. The element content of *G. procumbens* revealed high content of potassium, magnesium, calcium apart from carbon and oxygen while magnesium was highest in *G. procumbens* compared to *Goniothalamus umbrosus* and *Kaempferia galangal* (Siddig et al., 2009). However, magnesium has been reported to play a role as antioxidant and anti-cancer. Mineral element assay using EDX microanalysis indicated presence of Mg, Ca, P, C, O, K, Cl and Al in *G. procumbens* leaves (Siddiq et al., 2009) and therefore considered a potential source of nutrient element. Estimation of various mineral elements in medicinal plant is important in determining efficacy of herbal plant and their pharmacological activity (Fatanah, et al., 2016). An imbalance of mineral nutrient could alter the contents of flavonoids. Sulaiman et al. (2011) reported that deficiency of mineral elements such as Mg, Mn and K stimulate flavonoid accumulation in plant.

Phenolics: Phenolic compounds are among the major plant metabolites that exert effects on various physiological processes in plants such as photosynthesis, respiration, enzymes activity, protein synthesis, changes in membrane permeability, nutrient uptake, cell division and activate defense gene expression, members includes salicylic acid, chlorogenic acid, quercetin, gallic acid, scopoletin, 4 - hydroxy acetophenone and vallinin (Catherine *et al*., 2006; John and Sarada, 2012).Identification of optimum fertilizer rate is one of the agronomic requirements to increase crop growth and performance as well as the production of bioactive compounds. In addition to the above other researchers (Aires et al., 2006; Mohebbi and Maleki, 2010) have uncovered the fact that availability of plant nutrients and water can be important factors in determining secondary metabolism synthesis within plants. High nutrient availability leads to an increase in plant growth and development but a decrease in allocation of resources towards the production of secondary metabolites (Jeppsson, 2000). Antioxidant levels in *Brassica rapa* seemed to decrease as the fertilizer rate increased, especially under conventional fertilization (Zhao et al., 2006). According to Lila (2006), plant will contain higher levels of phytochemicals and antioxidant compounds if it has experienced some stress due to lower rates of fertilization during its development.

Reports had also shown that organically grown herbs are higher in total phenolics, carotenoids, vitamins and antioxidants as compared to conventional methods (Asami et al., 2003; Riahi et al., 2009; Ibrahim et al., 2013).

Flavonoids: Flavonoids are common constituents of plant used in traditional medicine to treat a wide range of diseases (Barbosa et al., 2007). Flavonoids are one of the widespread and diverse natural products in angiosperms, they were known to inhibit mitochondrial oxygen uptake and act as electron transport inhibitors, inhibit primary root growth and promote lateral root. Production of flavonoids, secondary metabolites, in herbs is strongly influenced by several parameters such as stress, nutrients, plant age and environmental conditions including temperature and light intensity (Ghasemzadeh et al., 2014). Similarly, factors such as cultivation and environmental conditions, fertilizer application, irrigation, plant age and harvesting time have been considered to significantly affect the level of bioactive compounds in herbs and crops (Dumas et al., 2003; Wang et al., 2013). *Gynura procumbens* demonstrated antioxidant activities and it leaves were found to contain active chemical constituents such as steroids, glycosides and flavonoids (Akowuah et al., 2009).

Antioxidant activity: The antioxidant activity of *G. procumbens* extracts was assessed via DPPH assay to measure its free radical scavenging ability (Akowuah et al., 2009; Afandi et al., 2014). In a comparative study, the ethanol extract of *G. procumbens* exhibited the highest percentage of DPPH inhibition (52.81%) among different types of plant extracts that were tested (Maw et al., 2011). Meanwhile, the reductive ability of *G. procumbens* extract has also been tested by using ferric reducing assay which has further proven the antioxidant capacity possessed by this plant (Kaewseejan et al., 2012). Further examination of the antioxidant activity via a range of different assays including trolox equivalent, β-carotene—linoleic acid, and xanthine oxidase inhibitory assays have also been explored. Based on the reported data, *G. procumbens* was found to display substantial antioxidant activity (Rosidah et al., 2008). Since lipid peroxidation is a common result of oxidative stress, the antioxidative effect of *G. procumbens* was revealed when it inhibited lipid peroxidation with the median effective concentration of 2.75 mg/mL (Luerang et al., 2010; Kumar and Pandey, 2013). In addition, the administration of methanol extract prior to oxidative stress induction was able to reverse the elevation of plasma lipid peroxidation in tested animals (Akowuah et al., 2012). In order to differentiate the antioxidative capacity of different parts of *G. procumbens*, a recent study was conducted by Krishnan et al. (2015). The study revealed that the root extract showed the highest antioxidant activity when compared to the other parts of the plant. Based on the studies, *G. procumbens* appears to be a potent source of natural antioxidants probably due to its high phenolic content (Rosidah et al., 2008).

Oral administration: Preparations of oral administration of *G. procumbens* leaves includes:

1. Herbal extract tablet or capsule
2. Herbal drink when fresh leaves were boiled with water or dry leave tea.
3. Cook with butter or soup
4. Dried leave powder applied on cooked food
5. Fresh young leaves or shoots can be eaten with rice dishes
6. Fresh leaves steamed and mixed with salads

Commercial uses: Among the existing patents related to *G. procumbens*, the majority of them are for preparations of traditional Chinese medicine intended for the treatment of various ailments including uterine cancer (Liao, 2015), cervical spondylosis (Shi, 2015), and chronic skin ulcer (Yang et al., 2015). Besides, it has also been used as an ingredient in special diets for patients with medical conditions such as heart and liver disease (Tan et al., 2016). In the food industry, it has been incorporated into products such as tea (Hu, 2014; Liao et al., 2014; Liu, 2015), coffee powder (Park, 2015), kimchi and chocolate (Tan et al., 2016), candy and chewing gum. The applications of *G. procumbens* in personal care and cosmetic products have also been reported which including hand-washing solution, hand sanitizer, oral spray and skin care creams (Tan et al., 2016). These patents have demonstrated the high commercial value of *G. procumbens* and its variety of uses in a number of industries.

Other uses: Young shoot and leaf are consumed fresh or mixed with rice or salad. It can also be cook to make a soup or sauce. The leaves are commonly consumed raw in Malaysia and Thailand, sometimes cooked (Kaewseejan et al., 2012). Young leaves or shoot can be eaten fresh or included in rice dishes, and mixed salad.

Conclusion: Gynura procumbens is highly recognized with therapeutic potentials in treatment of different ailments such as fever, malaria, cancer, diabetes, hypertension, hypoglycemia, constipation, rheumatism loaded and improve fertility. There is also a need to improve on its cultivation practice for enhancement of sustainable and production of *G. procumbens* through fertilizer optimization, planting

distance and harvesting interval for yield and commercial production, nutrition and health, ecological sustainability, economy, alternative medicine and food security.

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