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The Relationship Between Medicinal Plants and Food Industries: A Review Article

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ABSTRACT

Medicinal plants have played a vital role in human health and nutrition since ancient times, laying the groundwork for pharmacology and dietary practices. Historical figures such as Theophrastus and Linnaeus classified numerous therapeutic herbs, many of which have contributed to modern medicines. Today, herbs, spices, fruits, and vegetables are valued for their nutritional and therapeutic properties. This evolving "pharm-nutrition" approach emphasizes bioactive phytochemicals that bridge food and medicine. Plant extracts now serve as natural preservatives, flavor enhancers, and alternatives to synthetic additives. Regulatory frameworks vary: in the U.S., botanicals in dietary supplements are regulated as food under DSHEA without FDA pre-approval, while in the EU, traditional herbal products must meet pharmacopeia and WHO standards. The global dietary supplement market is expanding rapidly, projected to reach $300 billion by 2028, reflecting rising demand for natural health products. However, this growth raises sustainability concerns, with over 15,000 of the 80,000 medicinal plant species globally endangered due to overharvesting. Conservation efforts emphasize cultivation and biotechnological solutions such as tissue culture and synthetic seeds. Herbal components are increasingly incorporated into modern diets and nutraceuticals for their bioactive benefits. Scientific studies have isolated active compounds and validated their antibacterial, antioxidant, and therapeutic effects. While some herbs are clinically studied, many traditional remedies remain under-researched. Global research trends now focus more on drug discovery and functional bioactives than agronomic studies. Future directions include applying genomics, metabolomics, and digital traceability to ensure safety, efficacy, and sustainable use of medicinal plants within integrated food–pharma strategies.

KEYWORDS: Phytochemicals; Nutraceuticals; Botanical Supplements; Medicinal Plant Conservation; Pharm-nutrition.

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العلاقة بين النباتات الطبية وصناعات الأغذية: مقالة مراجعة

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تعليق توضيحي

لطالما أدّت النباتات الطبية دورًا جوهريًا في الصحة البشرية والتغذية منذ العصور القديمة، وأسهمت في تأسيس علم الصيدلة والممارسات الغذائية. صنّف مفكرون تاريخيون مثل ثيوفراستوس ولينيه العديد من الأعشاب العلاجية التي ساهمت لاحقًا في تطوير الأدوية الحديثة. تُقدّر اليوم الأعشاب والتوابل والفواكه والخضروات لقيمتها الغذائية وخصائصها العلاجية، في إطار مفهوم "التغذية الدوائية" الذي يركّز على المركّبات النباتية الفعالة التي تربط بين الغذاء والدواء. تُستخدم مستخلصات النباتات الآن كمواد حافظة طبيعية ومحسّنات للنكهة وبدائل للمضافات الصناعية. تختلف الأطر التنظيمية باختلاف الدول؛ فالبوتانيكالز تُصنّف في الولايات المتحدة كمنتجات غذائية بموجب قانون DSHEA دون الحاجة لموافقة مسبقة من إدارة الغذاء والدواء، في حين يجب أن تفي المنتجات العشبية التقليدية في الاتحاد الأوروبي بمعايير دستور الأدوية ومنظمة الصحة العالمية. ومع ازدياد الطلب الاستهلاكي، يُتوقع أن يصل سوق المكملات الغذائية إلى 300 مليار دولار بحلول عام 2028، ما يثير تحديات تتعلق بالاستدامة، خاصة وأن أكثر من 15,000 نوع من أصل 80,000 نبات طبي مهددة بالانقراض بسبب الجمع المفرط. لذلك، يوصى بالزراعة وتقنيات التكنولوجيا الحيوية كزراعة الأنسجة والبذور الصناعية لضمان استدامة الأعشاب الطبية. تشهد المكونات العشبية اندماجًا متزايدًا في الأغذية الحديثة والمكملات الغذائية نظرًا لفوائدها الحيوية. وقد نجحت الدراسات العلمية في تحديد المركبات النشطة وتأكيد فعاليتها المضادة للبكتيريا والأكسدة والالتهابات. وعلى الرغم من وجود تجارب سريرية لبعض الأعشاب، فإن العديد من العلاجات التقليدية ما تزال بحاجة إلى دراسات معمقة. وتشير التوجهات البحثية العالمية إلى تحول التركيز نحو اكتشاف الأدوية والمركبات النشطة وظيفيًا بدلاً من الدراسات الزراعية فقط. وتشمل التطورات المستقبلية تطبيق علوم الجينوم والميتابولومكس والتتبع الرقمي لتحقيق الاستخدام الآمن والفعال والمستدام للنباتات الطبية ضمن استراتيجيات الغذاء–الدواء المتكاملة.

الكلمات المفتاحية: النباتات الطبية؛ الصناعات الغذائية؛ المكملات الغذائية؛ المركبات النباتية الفعالة؛ الأطعمة الوظيفية.

INTRODUCTION

The medicinal properties of plants have been known for thousands of years, as evidenced by (Salmerón-Manzano et al., 2020). Many medicinal plants were used long before their active chemical constituents had been isolated. Historical texts show that the number of known recipes surpassed 1000. The Medieval century was rich in works dedicated to plants, giving birth to texts like the 'Herbarium' and 'De Materia Medica'. During the Renaissance, great botanists began to document many plants. The production of medicines was essentially based on herbs since ancient China, Egypt, India, Mesopotamia, and Greece. In China alone, 1850 plant species were referenced about 200 B.C., reaching 12,000 species by the 16th century. Modern science allowed isolated active principles from plants to be studied. The active principles of plants are now widely consumed, even if synthesized, analogy to vitamin C. During this lengthy historical process, the use of medicinal plants declined. Nowadays, the requirement for each prescribed medicine is a valid active principle known to have efficacious medical properties. Modern medicine has been practically reduced to industry-producible medicines, mostly as chemist-synthesized principles of medicinal plants. Currently, in underdeveloped regions with few medicinal drugs, the use of medicinal plants is still common. The reasoning is simple - medicinal plants are free - though cosmetic plants are usually paid for.

The interests underlying a return to traditional medicinal plants are multiple. Traditional medicinal plants are theorized to work better than modern medicine. In both Europe and North America, far more than 4 billion dollars are being expended yearly for herbal medicines. Some remain suspicious, especially with the proliferation of lower-quality questionable products. Scientific concern is over the rapid proliferation of herbal products with little research backing. In ethnobotany, the use of medicinal plants in traditional medicine must be scientifically studied. Efforts should begin by cataloging the plants used, their bioactive compounds, and the support for their ethnobotanical usage. Ideally, research on a medicinal plant would cover geography, plant species, and meditative activity. The geography focus studies a place where medicinal plants are strong and abundant, with independent consulting of users and wise men. Medicinal plants would be collected, dried, identified, and referenced in formal herbarium and database forms (Smith and Chinnappa, 2015)

HISTORICAL CONTEXT

The Sumerian clay slab from US, which states 5000 years old plants producing drugs on phyto-origins is the first written record available regarding use of medicinal plants for drug preparations. (Glesinger, 1954) What it enclosed were 12 drug-preparation recipes that contained over 250 different plants,no small quantity of them in the alkaloidide family, including mandrake, henbane and poppies. Around 2500 BC Emperor Shen Nung wrote the Chinese book "Pen T'Sao" describing roots and grasses. It contains a list of 365 drugs, or dried parts of medicinal plants — more than half

are still used in medical practice. India, where a lot of the spice plants still used today originated like cloves, pepper and nutmeg (Tucakov, 1964).

In the Jewish traditions of the Bible and Talmud mention is made in using aromatic plants like myrtle, incense and other compounds in rituals accompanying a healing treatment. Accordingly in Homer´s epics The Iliad and The Odysseys,both written around 800 BC. sixty-three plant species from Minoan, Mycenaean and Egyptian Assyrian pharmacotherapy are referred to. Many of those were even names from mythological figures in those epics. De Causis Plantarum (Plant Aetiology) y De Historia Plantarium (Plant History), libros de Theophrast (371-287 a.C.) conformaban la base sobre la que se fundaba física científicamente. In the books he categorized over 500 of those medicinal plants. The list of the well-known medical author Celsus (De re medica) contains approximately 250 medicinal plants like aloe, henbane, flax, etc. (Dimitrova, 1999).

Ancient accounts of medicinal plants, the most famous being by Dioscorides (the "father of pharmacognosy"), As he followed the Roman Army wherever they went, he researched medicinal plants. In 77AD "De Materia Medica was written by him. Everyone has heard of this famous ancient history book which has been translated countless times, and it includes a lot of data about the medicinal plants — the basics of materia medica which were used up to the late Middle Ages and Renaissance. Of the 944 medicines, the external appearance, location, method of collection, preparation of the medicinal preparations and therapeutic action are described in detail for 657 plant drugs. Together with the plant description, other language names of the same plant at its areas of occurrence or cultivation are also given (Toplak Galle, 2005) .In addition to wild plants, Dioscorides lists among the most prized domestic plants willow (Salix), camomile, garlic (Allium sativum), onion marshmallow (Althaea officinalis), ivy (Hedera helix), nettle (Urtica dioica), sage (Salvia officinalis), common centaury (Centaurium erythraea), coriander (Coriandrum sativum), parsley (Petroselinum crispum), sea onion (Limonium) and false hellebore (Veratrum). Another name of this herb is Chamaemelon and it is popular for its sediment cooling; it helps in the burns, stings, wounds or ulcers. Dakne, on the other hand, is used for rinsing and cleaning the mouth, nose, ear and eyes. It is ideal for children around.

For instance, his work "Historia naturalis" details around a thousand medicinal plants, Pliny the Elder (23 AD–79), a contemporary of Dioscorides. Whatever was known about plants and medicine at the time, were compiled in writings of Pliny and Dioscorides.

A Roman physician and chemist at that time, Galen (131 AD–200), considered to be the most famous of his age, made the first catalogue of interchangeable drugs with similar or identical actions, also known as as parallel drugs—De succedanus [22]. A few of the possible options are now

completely inappropriate in modern times, and will hardly work pharmaceutically. He did introduce a series of plant based medications that Dioscorides had not yet discussed as well This herb is still used today as it was back in the day, such as Uvae ursi folium for a mild diuretic and uroantiseptic (Bojadzievski, 1992).

MEDICINAL PLANTS: DEFINITIONS AND CLASSIFICATIONS

Medicinal plants are many plants that are used by people as drugs for the treatment of various diseases in many ancient traditional medicines. They play a significant role in the health care system of humans. Plants have been used by mankind for domestic purposes in general for centuries, i.e., as food, condiment, vegetable, flavour, beverages, etc. During this long period of acquaintances, many plants have also been discovered, whose parts and products have been found specifically effective in the treatment of various ailments, maladies, or diseases. Each culture of the world has developed its own traditional system based on the locally available medicinal plants. It is believed that in ancient and in many traditional health care systems, knowledge about the medicinal plants has been supplied through oral traditions for long. This oral tradition had restricted the growth of knowledge and development in this tropical science within particular local areas only, with very few exceptions (Beyene, 2016).

In the developing world, medicinal plants remain the mainstay of health care system for about 60% of population due to inaccessibility of modern medicines. The significance of knowledge, usage and marketing of medicinal plants has grown rapidly over the past decade worldwide. There is an increasing reliance on traditional medicine practiced by traditional healers and herbalists in developing countries and a parallel upsurge in medicinal plants and phytomedicine industries and systems (Salmerón-Manzano et al., 2020). They are also used as phytochemicals in pharmaceutical industries and flavoring or fragrance chemicals in food and cosmetic or perfumeries industries. Due to the increasing demand of medicinal plants in perfumeries and pharmaceutical and food industries and to its overexploitation, many of them are becoming rare, endangered and extinct. This warrants all out efforts to make rapid surveys of medicinal plants to compile the knowledge for preserving them for the benefit of mankind and the pharmacological industries.

NUTRITIONAL VALUE OF MEDICINAL PLANTS

Medicinal plants are widely used as a good source of nutrition around the world. Most of the food industries of many countries are engaged in processing medicinal plants as edible vegetables. Although, the food industries of the globe are much interested to extract bioactive principles from the edible vegetables for use as nutraceuticals, there is scanty information regarding the nutritional value of the medicinal plants that are mostly processed as edible vegetables in many countries. Thus,

analyzing the nutrient content of twelve edible medicinal plants that could have vital commercial importance was attempted before being consumed as food (Imran et al., 2007). Analysis of nutritional components of some wild edible plants. Journal-Chemical Society of Pakistan, 29(5), 500.

The experiment was conducted at the Research Laboratory of Ethnobotanical Studies and Biochemical Lab of the Department of Biology, University of Gondar from September 2013 to March 2014. Leaves of twelve edible medicinal plants were collected for this study. The samples were dried in shade for obtaining uniform dried materials and coarse powered materials. One gram of the powdered samples was digested. The phosphate was determined colorimetrically by vanadate–moly date method. The dry weight of the representative filleting water samples was determined by evaporating an amount of sample in a hot oven at 105 until a constant value was obtained. An amount of 10 ml of the digested sample was treated with a few drops of concentrated sulphuric acid and two milliliters of 30% H2O2. After cooling, five milliliters of 10% solution of an (NH4)2MoO4 were added and the blue color developed was read at 710 nm. (Sukmana, 2023). Most captured fish species were not found to be significance different in moisture content but significantly different in fat, protein and ash contents. Moisture, fat, protein, total ash and calcium contents varied from 79.124 to 90.823%, from 0.453 to 9.375%, 2.509 to 11.685%, 3.947 to 6.281% and 0.052 to 0.822% respectively. The observed moisture, protein and ash contents of Garra spp were the lowest while fat and calcium contents were largely in Barbus spp. It can be concluded that the examined fish are a very rich source of macronutrients and calcium. Further study is recommending analyzing the source of fish and linking the nutrient composition with the organism's feeding habit (Beyene, 2016).

MEDICINAL PLANTS IN TRADITIONAL MEDICINE

Medicinal herbs and plants have been used for treating various diseases since ancient times. Traditional healthcare systems, such as Ayurvedic, Siddha, Unani, and folk systems, have developed independently in different nations (Gupta et al., 2010). Knowledge of herbal medicines and traditional healthcare is preserved and passed down through generations. Traditional medicines are used for ailments like fever, malaria, cold, cough, asthma, jaundice, wounds, ulcers, small pox, internal tuberculosis, yellow fever, general weakness, and scorpions' bite. However, these plants are under-explored and poorly studied, and some contain dangerous active principles. Some plants, like daruharidra and asgand, can generate false expectations and are rapidly disappearing due to overexploitation (Salmerón-Manzano et al., 2020). On the other hand, the Cultural of Medicinal plants hold cultural significance worldwide, with indigenous knowledge being crucial for their conservation and sustainable management. The disappearance of plants due to human activity is alarming, and conserving these plants is vital for the planet's health. Ethnobotany, the science investigating plants and their local knowledge, has expanded over the last three decades, focusing on

indigenous peoples and their knowledge of local plants used for healing, construction, and food. Ethnodiversity, the rich cultural knowledge of different peoples and subcultures, is also studied in ethnobiology. Documentary ethnobiology, a rapidly expanding area of ethnobotanical research, addresses the urgent issue of local plant knowledge facing extinction in a homogenized world.(Beyene, 2016).

Case Studies

As an example, the knowledge and use of traditional herbal remedies for health care in Vilnius was investigated in a study (Salmerón-Manzano et al., 2020). An inquiry was carried out by employing a qualitative research technique. Eight primary health care physicians from Vilnius dialectal areas were interviewed via semi-structured interviews. Health care and health problems, communicative medicine, ordinary medicine, and actions were the topics that were investigated. It was discovered that Vilnius has been a significant center of public health care culture for many generations. Culture and traditions vary among people of various origins. They communicated health-enhancing concepts and folk wisdom from generation to generation, maintaining folk medicine and art. Ordinary medicine and community-oriented health care are deeply rooted in Vilnius culture.

There are frequent interactions among members of local Vilnius dialectal areas. The results revealed that ancient traditions prevail. It is widely believed that humans themselves create the essential conditions for maintaining health: devout worship of God, a modest lifestyle, a healthy diet, and a good Nature. Therefore, communication between humans and Nature is frequently regarded in the Vilnius dialectal areas as a cure that improves overall health and guarantees the absence of illness. As for health care services, primary health care physicians at Vilnius dialectal areas use referred and self-prepared medicinal plants.

The company bionkar is determined to be the key to unlocking the potential of green, sustainable extraction technologies. Their patented extraction technology takes extreme care of the integrity of plant materials and delivers environmentally friendly alternatives. Healthier, safer, and more environmentally friendly products are created with plant-based concepts and Bionkar investment in knowledge and affiliation with academic, research, and development institutes

Ayurveda and Unani systems highlight plants like Withania somnifera (Ashwagandha), Emblica officinalis (Amla), and Terminalia chebula (Haritaki). In Traditional Chinese Medicine (TCM), Panax ginseng, Ginkgo biloba, and Astragalus are widely used. Indigenous communities in Africa and South America rely heavily on Moringa oleifera, Vernonia amygdalina, and Cinchona officinalis (the source of quinine) (Mulingo, 2013). As well as Turmeric (Curcuma longa): Curcumin supplementation showed significant reduction in CRP and TNF-α in patients with arthritis and

metabolic syndrome (Hewlings and Kalman, 2017). Black Seed (Nigella sativa): Demonstrated improved glycemic control in type 2 diabetes (Kaatabi and et al., 2015). Ginger (Zingiber officinale): Reduced nausea, inflammation, and markers of oxidative stress in patients with osteoarthritis (Daily et al., 2015). Aloe vera: Used topically and orally for treating burns, ulcers, and IBS. Studies show mucopolysaccharides may aid in tissue repair and immune modulation (Reynolds and Dweck, 1999).

INTEGRATION OF MEDICINAL PLANTS IN MODERN FOOD PRODUCTS

The ever-changing lifestyles have made people focus on unhealthy eating habits, resulting in the prevalence of diseases. The worst effects are seen on young people, with growing obesity, cardiovascular diseases, and diabetes. Experts declared lifestyle modification as the most effective solution for this challenge. Community-based health consultations and interventions could effectively change eating habits. The rapid globalization of the fast food industry has changed the food habits of many people, particularly young-generation persons (Kumar Bera, 2010). Medicinal plants have been used as food since ancient times in many cultures. The recommended foods can be positioned as a bridge between traditional, herbal and on-track healthy foods in modern communities. Middle East countries can play a vital role in this process due to the presence of a rich variety of such foods. Modern technologies will make the traditional herbs easily accessible to the community as instant food products. New technologies can also be integrated into product designs and developments, which will make ordinary existing food products enriched as new product ideas. It is expected that these new foods will positively affect the food industry, nutritional applications, and health-related investment sectors, and contribute to improved health status (Ali et al., 2018). Many herbal plants have the potential to become a rich source of bioactive food compounds and nutraceuticals. As the herbs are of great importance in maintaining health, mitigation, and treating diseases, many pharmaceutical and nutraceutical industries are interested in producing extracts, compounds, and formulation products. There may be better opportunities to commercialize the field since many herbal plants are already in the process of producing products. Middle East countries are good representatives of this food-science-era challenge. Many efforts have already been made to develop issues related to quality, mass production, extraction, and storage of plant bioactive compounds. But many more efforts should be made on bioavailability, health claims, and food fortification process evaluation. These limitations should be solved in collaboration with food scientists, bioengineers, medical scientists, nutrostatisticians, and government authorities. It is expected that this review will provide roads toward bridging the medicinal plants and food industry with an emphasis on Middle East countries.

Functional Foods

The ever-increasing interest in functional foods has initiated manufacturers and consumers to be more aware of the health consequences of foods including nutrition- and health-enhancing properties of foods, beverages, and food ingredients (Rodriguez et al., 2015). The past few decades have seen innovations in the understanding of how foods or food components can be used to maintain or promote human health. The development of the concept of functional foods —foods with positive healthful effects beyond basic nutrition— is testimony to industries understanding of consumer expectations of new products. This expectation emerges from consumers increasingly educated about nutrition and the relationship between chronic diseases and diet and lifestyle choices. This expectation leads to innovations in product design and formulation. To meet consumers' psychological and scientific requirements, the conventional food and beverage industries need to become the functional food and beverage industries. Functional foods with health promoting or reducing disease risk potential hold a great promise in combating major lifestyle-related diseases, particularly in developing countries. The underlying idea of functional foods is based on the prevailing diet-related lifestyle diseases affecting large parts of the world, and particularly in developing countries, where the nutrition- or diet-related diseases are of pandemic proportions. The ever-increasing global production and consumption of these foods, however, raise questions on the safety of the novel bioactive food ingredients, which nowadays often do not meet general classification as nutrients but on the basis of their biological activities and health claims. To keep pace of this development, regulatory mechanisms should be established and the technology-based industries should have the required information on the safety and health implications of health-promoting food compounds using an appropriate and transparent methodology acceptable to both consumers and regulators, in concert with governments, academia, and the agri-food industries.

Health Supplements

Health supplements consist of products intended for ingestion as a supplement to the normal diet. They can contain vitamins, minerals, herbal extracts, amino acids, enzymes, or other ingredients. The form in which supplements are marketed is varied. They are presented as lozenges, syrups, powders, capsules, tablets, and tea bags. Supplements are not intended to diagnose, prevent, or treat any disease. They were originally sold in health food shops, but recent regulatory changes in North America and Europe have led to their almost ubiquitous availability by supermarkets, chemists, and newsagents. Most people don't consult their physician before taking supplements, and their use often exceeds scientifically based health recommendations. As with pharmaceutical drugs, some supplements may have significant adverse effects, despite their status as GRASE (generally recognized as safe) products (Di Lorenzo et al., 2015). Other supplements may have health benefits,

but these claims exceed scientific understanding. Certain vitamin and mineral deficiencies can lead to nutritional diseases, which can be treated successfully with supplements. A condition or deficiency not recognised as a health problem does not imply a product cannot be beneficial. The less understood effects of animal food supplements, particularly for weight control or for cosmetic benefits, are a source of controversy.

Botanicals have a long history of use as both everyday food and as dietary supplements in the form of tinctures, fluid extracts, capsules, or teas. In Europe and the USA, availability and consumption have rapidly increased in recent years. The wide availability of plant food supplements (PFSs), together with the proliferation of advocacy groups promoting their use, has now greatly exceeded scientific understanding of their benefits and adverse effects. PFSs are sold in a variety of forms including capsules, powders, extracts, teas, and tablets, either singularly or in mixtures. They can range from standardised extracts to ground herbs, and infusions to tinctures. They may be sold with or without accompanying health claims. This diversity of products coupled with inconsistencies in international legislation, particularly between the USA and Europe, renders differentiation from traditional herbal products, supplements and foodstuffs extremely difficult. Although many PFS cannot be classified as drugs, the term “plant food products” is likely to encompass a very wide variety of goods with different regulations. Randomized human studies on the efficacy of PFSs were found, but the majority were of poor quality. The possibility of serious adverse effects associated with some of the traditional remedies is well documented, but the potential for harm due to the widespread use of PFSs has only recently been reported. These serious adverse effects include hepatotoxicity, allergic reactions, autonomic nervous system effects, cardiovascular events, and grave renal complications.

REGULATORY FRAMEWORK

Herbal products are used more as foods than drugs in many parts of the world and are liable to food laws by their very definition. For food safety reasons, it is reasonable and indeed essential to establish food laws covering herbal products. For protection against unwanted formalities and costs on herbal products such as decoctions and metal cups, delegating the responsibility of council to designate which herbal products should be subjected to food laws or herbal food laws to the Asian herbal product industry’s association would be prudent and practical. Even the idea that it must be a law enforced by legislative bodies such as the Parliament usually sends industry representatives and civil society participants off on a different track that leads to the wars and pains of a less than reasonable solution to the problem globally.

Globalization, patenting of herbal substances, and unintentional threats from mass-researched

herbal products further complicate these schemes. At the same time, the treatment of herbal products as medications is a misinterpretation of state of usage by the mass. Herbal products are in no way conventional medications. By their very definition, they are no more than foods or food substances. There are many propositions on the definition of food as substances that should not claim as cure for disease. Reunion meetings of non-aligned countries in the mid-eighty's supported by WHO passed an accord declaring that all herbal products that have made it across boundaries and conditional acceptance of herbal products, etc. fall under declaration to food category defined in traditional medicine in article 27. Un changeability of food definitions serves governments well. Amending constitutions is excessively laborious, requiring national agreement and much time. While anthropologists should be mainly responsible for monitoring herbal products entering a country to see if they fit cultures, herbal medicine scientists should continuously record old and novel usages and put the database outside the grasp of legislative control.

In recent years, the world has witnessed an increasing awareness of herbal plants and their products both as traditional medicines and as food or food products (Anantha Narayana et al., 2024). Scientists working in the knowledge-intensive agricultural sector on cereal grains, legumes, vegetables, fruits, species, and herbs, as well as in animal and human health, have been alerted by the emergent fields of functional food for betterment of human health (Sanzini et al., 2011). At the same time, the global healthcare scenario has become more dynamic. International trade in herbal products is expected to escalate dramatically with increasing demand in various parts of the world amidst increasing disclosures about the hardiness and efficacy of these products. This is likely to broaden the healthcare choices of consumers. However, for some jurisdictions, access to herbal products is not a free and clear bid. Attempts to unduly hobbled their availability can result in increased public dissatisfaction. International experience shows that well-documented evidence of traditional use over an extended period of time can provide the confidence required in the safety and efficacy of herbal products.

Food Safety Standards

There is currently much concern about food safety in terms of the occurrence of undesired substances and the possible exposure to the consumers. Chemists and pharmacologists using herbal extraction technologies make efforts to assure that their products not only contain effective substances but also do not contain undesired substances importantly because health food is supposed to be safe food (Sanzini et al., 2011). It can be expected that some experts working on edible plant species e.g. researchers of medicinal food plants from the biological and agricultural side would work together with chemists and pharmacologists to defeat the lack of concrete scientific evidence about the safety of plant food supplements. Regarding food safety, it must be mentioned that plant food materials even

being safe natural products can sometimes offer undesirable complications for the food industry. In certain cooked food products some unwanted residuals of parent plants can cause unexplainable and noxosensory phenomena and developments. By investigating traps, the cause of the defect and unpleasant aroma has been detected. Volatile odorous compounds are formed in thermoconversion reactions of surface proteinaceous plant substances by means of their inhibition including some food preservatives and food additives. Aromatic food flavorings might form undesirable burned odor due to polymerization processes.

Food safety can be at least at two levels: (1) Safety standards generated by legislative institutions; (2) Commerce driven safety standards determined by food or health food chain industries. By the establishment of safety standard methods, the activities of undesired contaminants and plant specific traits can be determined. The source information of undesired contaminants, some of their pre-treatments and the applied methods are listed. The analysis should be mass spectrum indicative or absolute, if possible. The detection of plant ingredients and marker substances characterizing specific herbal preparations is comprehensive and a large number of methods have been elaborated. It is easy to choose a method suitable for the specific purpose. For health food products a selectivity similar to medicinal plants is needed to guarantee their safety. It must be emphasized that regarding safety standards an important shift of situation has emerged or is emerging by the establishment of food safety regulations in the course of globalization.

Labeling Requirements

Nutritional and medicinal claims are often made in relation to herbs and herbal products. These claims can be made in one form or another in all parts of Europe since the Juices and Juices Products Regulation EC just came into force (Sanzini et al., 2011). However, the claims permitted differ in different parts of Europe because different markets exist and different codes, usually implicit, govern these markets. In some parts of Europe, herbs and herbal products are regarded as natural plant preparations and, as such, are taken, sold and discussed in general terms as natural products. Generally speaking, any herb or herbal preparation can be mentioned, discussed, sold or advertised, provided that the claims made are truly descriptive of the herbal product. Other countries are more stringent with respect to claims that can be made. There are also differences in how clear an overview is as to what claims or assertions are considered acceptable. Across Europe there is an increasing demand for scientific evidence to support the claims that are made about herbal products.

The aim here is to carry out an analysis of regulatory frameworks relevant to claims made with herbal products at different levels: international, European and national. A specific focus will be on the comparison between Sweden and the Netherlands. Sweden and The Netherlands are both

sample countries of wide traditions with respect to herbal products, and they represent two markedly different systems of regulating claims. The analysis will include a description of the respective rules and of their practical implications, previous steps taken to harmonize the regulation of claims at national, European and international levels, and considerations as to whether further steps should be taken to achieve better convergence.

MARKET TRENDS AND CONSUMER PREFERENCES

Over the past decade, herbal remedies and botanical medicines are now engaged as an alternative of the synthetic drugs. However, the globalization of herbal products poses challenges to the food and medicinal products regulatory authorities in both developed and developing nations. Diseases and conditions, for which no effective treatment is available in orthodox medicine, such as cancer, cardiovascular, diabetes, and many others, push herbal medicine into the limelight. Factors, which account for distrust in orthodox medicine are: initial skepticism of the danger of synthetic drugs; safety of almost all natural products; and zeal for the novelty of finding the obscured information in the ancient vedic texts, manuscripts, and folklore (Salmerón-Manzano et al., 2020).

Notwithstanding the above, scientific journals dedicated to herbal drugs, supplemented with the extensive studies, are still not enough for their effective regulation. The scenario further gets complicated, when the regulatory guidelines, particularly as concerns to the natural components, and by the industries themselves, in terms of a quality assurance are either incomplete or avoided. As efforts to make the best possible quality response of herbals, quality tests for the components and products contents are enumerated herein; to mention those, crude herbs, extracts, standardized extracts, and products.

Demand for Natural Ingredients

Recent trends in cosmetic, pharmaceutical, detergent, and food industries worldwide show a growing demand for consumer products with natural ingredients. Industrial concern over synthetic chemicals, with their adverse environmental impact and increased public awareness of the safety of products of natural origin, has brought a dramatic increase in the global market for natural ingredients (Atanasov et al., 2015). The development of new consumer products from a primary resource, whether plant or microbial, is now largely driven by demand. To keep pace with an existing market or breach into new ones, innovative consumer products must be available. The dynamic nature of natural product demand, coupled with a long and comparatively slow process of effective compound discovery and product de-registration, has hampered the development of the pipelining of new products from natural origin. Procedures for bioassay, extraction of active compounds, and their preservation in the necessary quantity, variability, and viability have developed. No flexible method

exists for effectively discovering and customizing active compounds from new source organisms (Kumar Bera, 2010). The gulf is widening between the affordable low-multiple active compound amount consumer products and the increasing price requested for the same therapeutic action by natural ingredient suppliers.

On the other side of the trade, biological activity evaluation procedures for safety data packages and efficiency monitoring of final consumer products, which would allow for defending interests in a potentially opposite competitive situation, have virtually not developed. The marketed ingredient industry is, in this sense, an unsophisticated technology sector given the existence of efficient bioassay procedures for discoveries, monitoring, and counterfeit detection. Ultimately, regardless of capacity, the only option which can be exploited is active compound resupply from the original source. Inevitably, highly profitable natural products affected by scarcity or legal protection are at risk. Industrial damage is highly probable and irreversible. Current estate blocking and statute of limitations-based agreements do not guarantee a reliable supply situation. Therefore, the need for a technological breakthrough is pressing

Consumer Awareness

Much of the uncertainty and risk that comes with using a specific product of traditional medicine also comes from unsafe preparation methods. This is a collective problem for both industries involved, and thus far this problem hasn't been efficiently approached on either a regional or global scale. Co-operation and awareness will cause a matter like using untested sources to be decreased, only primitives of both industries are able to fully appreciate what is at stake. The global trade in herbal remedies poses real risks. The globalization of trading these products has caused unexpected problems in both the supply and demand chain, such as pollution and waste management issues. Mass production also allows the means for mass contamination of natural sources, with major products like ginseng or Echinacea becoming increasingly scarce or polluted on the conventional market.

This supply issue is worsened by a major increase in market demands of natural remedies. It has become an industry worth billions. As with all growing industries, newcomers will flood in and attempts to dominate will be made. In this case, not only new companies from actively and well-established bases of production are cropping up, based in for instance the UK, massive companies with baseline origins in western monocultures and other synthetic herbal production bases aiming to seize the untapped benefits of the fields of Asia and the past knowledge of herbs, are entering the market. Due to this information imbalance, countries like India run the risk of losing account of all economically viable natural sources, and after a decade of co-operational companies operating much of the raw resource trade being overturned with the market becoming increasingly lucrative, the

secure return on an underegulated free hand approach will no longer be there. On a governmental level, Pakistan and India are offering tax waivers for the herbal preparations done outside of the producing country: these governmental loyalties lead to blatantly unfair trade agreements. An increasing consumer awareness into “held accountable”, “fair trade”, and “sustainable trading” proves these mismatches, but from both sides of the two industry structures the information currently available to deal with the other on an equal level of understanding is scarce (Kumar Bera, 2010).

CHALLENGES IN FOOD INDUSTRY INCORPORATION

Despite being a decentralized family business in the past, the Indian food processing industry has been transformed into a mechanism of modern Indian economic rejuvenation. A single dynamic agricultural and food sector faces many barriers in terms of investment, infrastructure, and socio-economic factors which inhibit its growth on a larger scale. Agricultural production is seasonal, highly price susceptible, and focused on food grains. The perishability of the raw materials, as well as a highly fragmented manufacturing process, worsen the problem. The food processing sector, which is one of the 25 Principal Industries in India, contributes around 7 billion dollars, or 6.30 per cent to the country’s economic output. However, it is estimated that more than 30 per cent of food products perish every year due to either lack of processing facilities or technical expertise, which yields wastage of potential revenue, land, labor, and natural assets. Plants are processed, conserved, and improved into processed foods, food ingredients, and food additives in the food processing industry. These processed foods, which may be semi-processed or finished, value-added commodities, are sold directly via wholesale food markets and retail establishments such as grocery stores, supermarkets, and hypermarkets (Kumar Bera, 2010).

Food ingredients, food flavorings, colors, fillers, preservatives, and nutraceuticals are all components of foods processed for food industries. On the other hand, ingredients such as starches, sugars, fats, proteins, emulsifiers, and hydrocolloids are used in food formulations (Atanasov et al., 2015). The enhancements of desirable qualities in real foods, ranging from cooking and fermentation to extrusion, drying, and heating, imply the processing and transformation of the foods. Similarly, processed ingredients may be used intelligently to achieve the desired flavor, color, texture, appearance, and shelf life of a food product. Though the agricultural industry is not a subject of this publication, it is noteworthy to point out that Indian agriculture is dominated by cash commodity crops like sugar cane, cotton, and fruits and vegetables, which are traded either as raw commodities or crude processed products. Medicinal plants are mainly grown in India by ethno medicinal communities in the wild and surroundings of villages by shifting cultivation or practiced in home gardens or as agroforestry by tribes and plantation grounds. These medicinal plants are used for the primary health treatment of common ailments in infancy with Vaidyas. Due to structural, technical,

and socio-economic reasons, the world has turned to these plants and communities for the validated use of well-known medicinal plants and for discovering new ones

Standardization Issues

Standardization of rural and medicinal food, both in raw and finished forms, needs particular attention as these are obtained from natural sources. Freshly harvested green leafy vegetables contain nutritional quality (protein, minerals, vitamins, and fiber) much higher as compared to fresh vegetable products. In vegetable processing industry, concern about finished product quality (mainly organoleptic) is given more emphasis and may differ from season to season. At the same time, raw materials of vegetable based food & their processing byproducts may have relatively better nutritional quality (Chawla et al., 2013). Quality Control parameters defined and decided by food processing industries and regulatory authorities may not be wholly adequate for quality assurance of food products on regular basis. Quality control assessment of vegetable food products in the processing industry requires specific parameters for green leafy vegetables that are different from other vegetables. The proper consideration of quality control parameters during industrial processing of green leafy vegetables such as spinach, cucumber, curry leaves, and fenugreek removes bitterness and is necessary to meet consumers' day-to-day health safety and organoleptic quality expectations. Quality control of individual ingredient and overall product is important prior to commercial production of raw or finished product. Routine food product quality control records are vital for food safety, preventive measures, legal obligations, & for further research.

Quality control of food supplements of plant origin is essential to ensure that their safety, efficacy, and quality is consistently demonstrated and that they comply with the regulations applicable in the EU. Guidelines for the regulation of food supplements were established in 2002 by the European Parliament, framing an appropriate legal framework for their marketing in the EU notwithstanding significant differences in the member states' national legislations on this topic (Sanzini et al., 2011). Food products in the EU must be safe for human consumption and must not mislead consumers in terms of identity, properties, or safety. The EU Regulation 1924/2006 states that food products may not contain nutrient or health declarations that mislead consumers or are based on misleading or unfounded scientific claims. Products must be lawfully placed on the market in their country of origin and must not be approved drugs, rejection of which is in the interest of safety or efficacy.

Sustainability Concerns

Medicinal plants account for the primary health care source for nearly 85% of the overall population in developing countries, where they are mostly used for traditional allopathic healthcare

systems. According to a comprehensive survey covering 3378 medicinal plants, 1247 (37%) are totally horticulturist-gathered plants, while 617 (20%) are both cultivated and gathered. Apart from their health-aiding properties, they are also being used immensely as dietary supplements, foods, and food additives. The revenue of the global medicinal plant market generated was 508.39 billion in US dollars and is projected to reach 50 trillion in US dollars by 2050. Medicinal plants are facing excessive unsustainable harvest from wild wilds, which may lead to runaway harvesting and extinction of species, disruption of ecosystems, imbalances of food webs, and loss of biodiversity (Jiang et al., 2022). Unsustainable wild harvesting of medicinal plants is regarded as a major extinction driver. Over-harvesting creates population sinks, reducing fitness, resilience, and population sizes. Most threatened medicinal plants are in the tropics. Approximately one-third of medicinal plants expected to use in the next few years are on the verge of extinction when considering more extensive uses.

Causing ecological issues and environmental effects at multiple levels are inevitable. Intensive agriculture brings significant food supply; however, it raises environmental issues as interdependence and interconnectedness increases. The intensive use of both chemical fertilizers and pesticides may lead soils to degradation and loss of fertility. Continued mechanization brings desertification and increased erosion. Elderly diseases and cancer-like diseases led by pesticide residues and heavy metals are prevalent due to the widespread use of synthetic pesticides, herbicides, and fertilizers. High sickness costs and related external costs account for more than 58% of gains in high chemical use. Despite the lower yield, organic agriculture is a promising alternative to conventional agriculture. Organic agriculture grows agricultural products without the synthesis of agro-chemicals. For medicinal plants, the quality is more important than food crops' quantity. Switching from conventional to organic agriculture will improve the quality of medicinal plants.

Organic agriculture promotes the restoration of favorable agricultural conditions, such as increasing soil fertility and reducing soil compaction. As an active substance in fungicides and pesticides, copper accumulated in the soil and was involved in the facilitation of the degradation of labile organic matter, which may further reduce soil diversity loss. Cropping systems play a key role in preserving functional biodiversity because it determined the primary conditions for insect and plant diversity and abundance. In particular, organic farming systems are generally more beneficial for native insects and plants. Though promoting organic cultivation of medicinal plants, supporting and implementation will involve greater funding, focused research, extension efforts, and openness of many governments in both developing and developed countries. More comprehensive scientific research into the effect of new technologies in the organic agriculture systems on the medicinal quality and sustainability of medicinal plants is required in the future, especially for less studied

plants.

SCIENTIFIC RESEARCH ON MEDICINAL PLANTS

Research on medicinal plants is currently a hot topic. Current studies on this subject are virtually nonexistent. The present review attempts to evaluate the state of medicinal plant research using bibliometric analysis over the last fifty years and to present a collective outlook into the future (Salmerón-Manzano et al., 2020). This review provides an analysis of the most prolific countries, institutions, researchers, journals, keywords, research areas, and limitations and suggests further avenues for future research in medicinal plants. It was evaluated 54,081 articles containing the words medicinal plants from the Science Citation Index Expanded database by cross related scientific indexing. The annual worldwide publication trend on medicinal plants grew rapidly from 1974 to 2018. However, it decreased in 2019. The USA was the major contributor to the benefit (n = 16,960, 31.33%). The university of Madras also had the highest academic impact (4,155 citations). The most influential journal was the Journal of Ethnopharmacology (n = 7,833, h-index = 249). The highest cited article was published by A.P. Firman. Biochemistry and molecular biology were the most widely distributed research areas (n = 19,830 articles, 36.67%). The most used keywords in the articles were medicinal plants (n = 7,340 articles, 13.57%), ethno-pharmacy (n = 2,228 articles, 4.12%), and phytochemistry (1,091 articles, 2.01%). This investigation into the medicinal properties of plants in the broadest sense may provide a bird's-eye understanding of medicinal plants and the insights needed for policymaking regarding relevant research areas.

Phytochemical Analysis

Phytochemical composition plays a key role in understanding the properties of plant material. Recent studies on that topic have focused on the antioxidant activity and mineral characteristics of vegetables and fruit (Oliveira et al., 2017). Work has also dealt with the effect of storage on nutritional composition. Other pilot studies studied the influence of temperature and light on the content, phenolic composition, and antioxidant properties of some medicinal plants; it has improved the knowledge of the phenolic content and antioxidant properties of plant materials with known ethno-botanical use and screened local medicinal plants for those constituents. The wider impact of cultivation conditions on the phytochemical profile of food plants comprising several descriptors learned about the impact of water, harvesting period, and fertilization on the phytochemical profile and health status of medicinal and ornamental plants. Research concerning harvest time effects on the content and yield of several types of secondary plant metabolites contributing to desirable properties. Research also focused on the biochemical stages of the developing leaves of Melissa officinalis, as agricultural factors can cause stress on plants and alter their health and quality.

Sustainability is the future and a challenge for the medicinal and aromatic plants used in the food or beverage industry.

Regarding the three aspects of characterization, further work is needed on understanding the most productive and less expensive cultivars and the best preparation method. Multivariate approaches, either chemometrics or simple correlations, can be helpful in that respect. More generally, a comprehensive and holistic approach will be key to characterizing their physicochemical, morphological, and biochemical properties at inter- and intraplant levels. Considering the narrow scope of most of the studies reviewed, it is apparent that the broader question of characterization should be deepened. Fields of study emerging from the literature should particularly focus on the intervention of farmers, meteorological, and climatological variables. Climate change is of great concern in Europe. Changes in plant distribution, growth period, yields, and adaptive transgenics are likely to have implications for the food industry, and future studies should strive to understand these impacts to either mitigate or take advantage of them.

Clinical Trials

The absence of a designed-phase clinical trials on food plants and nonfood plants as medicinal plants does not mean that products are not being studied at larger scales. “Clinical trials” are only one segment of a large body of scientific research exploring pre- and post-market opportunities, use of ingredients, and product conception and design. Studies utilizing weight loss, cognitive function, and cardiovascular quality of life outcomes are widely employed at tier 1 to tier 6 settings around the world, although validated claims are a rarity.

Most of the above studies are funded or sponsored by food, herbal supplement, and beverage industries to expand the share of consideration of products in purchasing and utilization decisions. A secondary use of studies funded or sponsored by wellness trade associations serves to explore broader usage adoption and incorporation in consumer products.

There is also well-known efficacy driven academic herbal research studies at top tier 3 to 3+ settings that have published findings on both safety and health benefits of ashwagandha and turmeric. These studies have questioned short exposure FDA GRAS safety designs of many products (Funk and Schneider, 2021) and stimulated a large body of clinician and herbal industry-led herbal safety studies.

CASE STUDIES OF SUCCESSFUL INTEGRATION

Many companies worldwide rely on traditional plants in their food production, combining medical properties with the preservation of indigenous knowledge within local communities. Three

model case studies are presented: Baobab Products South Africa, Origine, and Mycofarm. (Salmerón-Manzano et al., 2020). Baobab Products South Africa has been operating since 2004 in Johannesburg, processing the Adansonia digitata, one of the African and South African "Letaba Seven Natural Wonders of the world." Baobab is rich in vitamin C and anti-oxidants, and can be sold as fruit powder for various products, including drinks, purees, jellies, jams, sauces, professional ice cream, bakery products, and directly as raw fruit. Origine has operated since 1996, processing honeys originating mainly from Italy, concentrated vanilla pods from Madagascar, and edible flowers from Campania (Atanasov et al., 2015). In this article you will learn how to maintain food without using any chemicals but using rosemary extract. Only, they taste and smell awful and are hard to swallow. Regardless, nowadays you can get new rosemary and it will not color or odor anything. Several studies have demonstrated that the bioactive compounds in extracts and essential oils from rosemary inhibit bacterial and lipid oxidation. This in turn keeps the food fresh for longer! Pick up from the above, it is easy to say that rosemary extracts can be applied in plant products, medications, functional foods and food preservation. In 2018, (Nieto et al., 2018) This all-natural extract can be added to many salty as they desire including meats oils, and dressings. Investigation of the possible health benefits by inflammation attenuated using herbalism as traditional way in (Serrano et al., 2018). We aimed to review the anti-inflammatory properties of some traditional plants, which have rarely been studied from a dose-response perspective. These are citrus fruit extracts containing hesperidin, camu-camu (Myrciaria dubia), black currant (Ritis nigrum), devil's claw (Harpagophytum procumbens) and cat's claw (Uncaria tomentosa). The chocolate and tea had similar or significantly better performance than each of these extracts. They also talked about what they already know about the extracts' mechanisms of action and how the multiple compounds in them could synergize to enhance their activity (Chiocchetti et al., 2018) looking for new sources of nutrients, established a challenging diet model including whey protein and inulin. Food by-products The pool of substrates evaluated as a potential carbon source for the growth of probiotic bacteria consists in jackfruit, cucumber peels, cupuaçu seed peels, pumpkin and rice bran (Li and Authors, 2018). In this article, we will try to examine how fiber, tannins and phytic acid interfere with iron uptake thereby modifying iron availability. Other interesting compounds killing fungi were identified[hash] The study authors explained that other by-products, such as the peels of cucumbers and pumpkins, could play a role as a bioavailable source of iron for those who are lacking in this nutrient. These byproducts could have a major effect on their iron consumption. study have been conducted on the generation of new commodities from process cucumber and pumpkin peels as well as isolation of novel by-products which can be used more significantly available sources for iron. In two fractions of a Euphorbia dendroides L. plant, (Ghout et al., 2018), their search for bioactive compounds on humans selectively acting chemicals is reported by Zerbe. Print Writer JavaScript initialization Garlic and chlorogenic acids are considered two of

the most important because they suppress cell division, as well as kill fungi. Both extract showed anti-proliferative and cytoprotective effects. Both extracts of Euphorbia dendroides L. were excellent based on their levels of total phenolics and flavonoids in the strong lysis lipids, reducing power and antiradical activities. Researchers for instance, in a recent study we (Agregán et al., 2018) evaluated the antioxidant capacity of aqueous and alcoholic solvents through a novel non-conventional environmentally friendly extraction technique, namely ultrasound-assisted extraction, on two microalgae (Spirulina platensis and Chlorella vulgaris), and three brown macroalgae species (Fucus vesiculosus, Ascophyllum nodosum; Bifurcaria bifurcata). Furthermore, the extracts of Bifurcaria bifurcata and other macroalgae have been shown to possess phenolic antioxidants in substantial number. Yes, you can eat them in your diet. In searching for bioactive compounds with physiological effects in the crude methanolic extract of the aerial parts from Capnophyllum peregrinum (L.) Lange (Apiaceae), collected in Algeria, Lefahal and co-workers published a study (Shafiee et al., 2018). They talk about some materials that work well on fungus. The methanolic extract possessed a significant amount of flavonoids and phenols. The affords pores and skin a natural protection from the sun, in turn making it useful for the dermis. Natural sunscreen and natural antioxidants in medicines or cosmetics. conducted a study where This review describes the antioxidant potential of polyphenolic compounds in Stachys mucronata according to the antioxidant activity demonstrated by (Grigorakis and Makris, 2018) and combatting free radicals. The most important parts according to the authors were flavonol glycosides, luteolin-type flavones derivatives, chlorogenate conjugates and apigenin analogues. In the extracts, the most effective radical-scavenging compounds were present in n-butanol fraction which is considered as the best antioxidant of Stachys mucronata. Information obtained from our study is essential in future research seeking to weigh the effective biotic effects of S. mucronata, an area that was hitherto not assessed at all. (Martínez et al., 2018) detail the use of components of hydroxyl tyrosol (HXT) as a fabric for improving meat flavour. Here, they talk about the most recent research on how using HXT in meat could be good for you. The well-ordered plan of its particles implies a large number of reasons it’s vastly preferable for your wellbeing to eat than drink. Like anti-inflammatory, antioxidant and also skin and eye protection. It also fights cancer. Hence, mixing HXT extract with meat products is better than using synthetic chemicals. As the extract is extracted it has a strong aroma and flavor which needs to be neutralized by a pre-treatment of the extract before addition such that with addition of products there would not be any off taste or odor in the meat product. Currently researchers are working to develop emulsion gels and capsules that contain the extract so that the meat products don't taste or smell differently. It can be employed as a direct fed ingredient or on the animal's diet, licensing, or in innovative ways with meat. studied the impact of Mespilus germanica L. concluded hydroacetonic extract on blood glucose level and homeostasis in Balb/c mice induced by streptozocin-diabetis. (Shafiee et al., 2018). The present

investigation was aimed to explore the antihyperglycemic, antioxidant and body weight reducing activity of Mespilus germanica L. leaf extract in normal BALB/c mice as well as streptozotocin-induced diabetes. Compared to control group the leaf MESP extract of Mespilus germanica, effect positively decreased blood sugar levels and body weight was maintained in diabetic BALB/c mice. Moreover, this extract also diminished lipid peroxidation and oxidative stress being two defense strategies against the negative influence of paracetamol.

FUTURE DIRECTIONS

Sustainable food production is one of the greatest challenges of the current century. For plants, sustainability includes securing the race as several diseases and events could potentially annihilate the race. This is further complicated by the challenge of intensive agriculture, which tends to accentuate monoculture and specialization. Studies on the history of plants tend to reveal wild relatives critical for crop evolution. Among several plant families, the family of Legumes is one of the past and present success stories in food supplies. Besides their unique ability to fix atmospheric nitrogen, legumes are a diverse group of more than 19,500 species. Recently advances in legume genomics have made it possible to start focusing more on some aspects of legumes which were neglected in the past. A plethora of unresolved questions remain to be tackled and legumes should be regarded as a wondrous and entertaining field of research (Salmerón-Manzano et al., 2020).

Medical plants are sources of candidates for new therapeutics for human use. The core of a collection of such plants from diverse regions along with local knowledge to find new treatments has been applied for decades as a factor contributing to medical and economic development. However, as the information increases in sizes, it is becoming more challenging to tease out the factual knowledge. It is only fair to ask whether certain gains influence the schematic which forms the bases of medical plant selection for modern research. Given the evolution from folk to modern biomedicines on the one hand and the potential crisis facing both lines of choices on the other, it has become imperative to examine the current flow of information about secondary metabolites, medicinal plants, and pharmaceutical agents/products. The aim is to identify major gaps and hence needs in medicinal plants and drug discovery knowledge and efforts.

Emerging Trends

The potential of plants as sources of medicines and drugs has been known since antiquity, as parched Egyptian papyrus records show some plant treatments from the second millennium B.C. (Salmerón-Manzano et al., 2020). From the mid-sixteenth century, interest in botany led to the description of numerous new species, but it was not until the second half of the nineteenth century that the rapid expansion of the use of medicinal plants began. Nowadays, modern medicine is based

on pharmaceutical medicines, which are either harvested from plants on extraction plants or developed from active principles already discovered in plants. The progressive abandonment of traditional medicine is a hallmark of the modernization process of mankind, followed by political and industrial revolutions, wars, and mass migration processes. However, the unforeseen consequences, among them pathogenic resurgences indications of sanitary negligence, and the appearance of diseases not recorded to date, such as prion ones, created doubt with regard to the superiority of that traditional medicine, which prior to this modernization process had shown excellent results.

Humanitarian attempts to address the problem, without respect to sanitary, pharmaceutical, and legislative rules and institutions, with the introduction into the market of plants circulating freely but unresearched, and previously unknown to pharmacognosy as well as considered dangerous by the sanitary institutions of the countries of origin, generate a catastrophe. This included the well-known example of the pharmacognostic use by the Mexican population of the ripe seeds of bitter melon, which constitute an excellent antidiabetic. However, the seeds also contain highly toxic active principles and a wave of intoxications leading to multiple casualties as far as coma was recorded. This case illustrates the perverse prospects that the unknown process creates considering that these plants may alter the glycemia of populations that do not know their adverse effects. A similar example of a total failure of regulation is currently occurring in France with purple coneflower, plants acknowledged to be effective in the treatment of common flu. In this case, products marketed included all tissues and organs of the plant including dangerous alkamides and oils, although only homogenated aerial parts were pharmacognostically controlled in detailed pharmacopoeial monographs.

Research Opportunities

Modern-day science has yielded complex evidence that seems to explain the therapeutic potential of innumerable medicinal plants. But, there are still countless plants either unknown or botanically, chemically, or pharmacologically undescribed, which are actively used by local healers and communities. Researchers are conducting studies on an ongoing basis to find the new plant resources for phytochemical and pharmacological investigations. The possibilities of work in this regard are unlimited, as there are many unexplored biogeographical regions. New, traditional, or introduced horticultural systems need to get documented closely and scientifically. Soaring scientific interest in unexplored flora is well illustrated by recent publications of worldwide research trends on medicinal plants (Salmerón-Manzano et al., 2020).

The positive utilization of plants by humans has been around for at least 60,000 years. The plants have always been at the center of every society that existed on earth. Plants have been vital in

shaping the culture, rituals, and cuisines of numerous people and civilizations worldwide, including the first pre-historical human tribes to modern urban societies. A variety of phytonutrients that plants produce during the complex process of photosynthesis has proven invaluable in nutrition, health, flavor, color, and fragrance. Medicinal plants have developed, evolved, and complexly regulated different phytochemicals as secondary metabolites. An interesting observation is the confusion among many clients regarding the terminology. Notably, medicinal plants have also steadily been considered functional food ingredients used in diverse ways in human diets since prehistoric times. Still, the scientific approaches to medicinal plants and food plants have been almost exclusively discussed separately by the researchers concentrating on either of two areas.

CONCLUSION

This in-depth scientific analysis examined the historical, current, and future use of medicinal plants in the food industry, as well as the health, nutritional, and industrial contexts in which this integration could occur. The study began by discussing how long people have used medicinal plants. Ancient civilizations like the Sumerians, Egyptians, Chinese, and Indians used them, and by the 16th century, there were records of over 12,000 plant species. Even the industrial medicine has made significant progress and relies on man-made active molecules, medicinal plants remain highly important in traditional healthcare systems, particularly in developing countries, due to their accessibility and affordability. In developed countries, herbal medicines are also gaining popularity, even though there are issues with product quality and a lack of sufficient scientific evidence. This study discussed how medicinal plants are classified botanically and the nutrients they contain. It focused on how they are employed as a source of nutrients and biologically active compounds in the food and pharmaceutical industries. It also examined real-life examples from places like Lithuania and India to demonstrate how combining traditional knowledge with modern study could potentially contribute to the creation of curative food products. The review also discussed the challenges associated with using medicinal plants in the food industry, such as ensuring the plants are safe for consumption, meeting quality standards, adhering to labeling regulations, and ensuring the sustainability of plant resources and the preservation of biodiversity by preventing overharvesting and intensive farming. This study was discussed the importance of functional foods and dietary supplements made from medicinal plants. It also pointed out that there are no universally agreed-upon rules, which leads to different policies and procedures in different nations. It also emphasized the necessity for more phytochemical analysis and robust clinical investigations to ensure the product's efficacy and safety. Finally, the review discussed new trends in the use of medicinal plants and called for scientists, businesspeople, and lawmakers to collaborate to establish an industry that is data-driven, sustainable, and prioritizes health and food safety, ultimately benefiting both the

economy and public health. (Salmerón-Manzano et al., 2020).

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