Introduction | CHAPTER 1

1.1 Introduction

Prunus persica fruit found in Assam is a wild edible species of peach and is locally known as Nora bogori. It is a deciduous plant with drupe fruit belongs to the Rosaceae family [1]. The author Antoine Laurent de Jussieu coined the characteristic term ‘Rosaceae’ to the family evidently based on one of its significant entities Rose [2]. [The International Code of Botanical Nomenclature (ICBN) (2006)] A large no. of about 3370-3500 species [3-6] and 90-125 genera of trees, shrubs and herbs [heywood] comes under this family. It is divided in four subfamilies viz. Amygyloideae, Maloideae, Rosoideae and Spiraeoideae. From these subfamilies, the fruits of genus Prunus included under Amygyloideae subfamily are characterized by a clear ventral suture, a membranous exocarp, [4] with an outer fleshy mesocarp [7]. The seed is surrounded by a hardened endocarp shell and a mesocarp layer over that and due to this, various Prunus species are also referred to as “stone fruit”. Like other stone fruit, peaches have a characteristic, lignified endocarp (pit or stone) that encloses the seed, a fleshy mesocarp and a thin exocarp [8].

1.2.1 Classification of peaches:

Classification of peaches in different categories are done based on color, adhesion of the pulp to the stone (endocarp), and texture and firmness of the fruit. Depending on color it can be white-fleshed or yellow-fleshed; different degree of adhesion of the pulp to the stone gives rise to the categories like freestone, clingstone, or semi-freestone pits [9,10]. Further classification based on the texture and firmness of the fruit divides the peaches with melting, non-melting, and stone-hard flesh. Nectarines are essentially indistinguishable fruits from peaches. They differ in terms of their skin texture variations which is a characteristic property of peach fruit. Due to the lack of trichrome nectarine fruits have a smooth skin texture compared to the fuzzy peach. In addition, cultivars are also classified according to (i) flowering time (very early, early, intermediate, late, and very late), (ii) ripening time (extra-early, early, intermediate, late, and very late), and (iii) fruit utilization (direct or fresh consumption, or industrial processing), fruit acidity, yield, quality (taste, aroma, texture, and flavor) and sensory qualities (sweetness, acidity, and astringency) [11-13].

Peaches and nectarines are subjected to intensive breeding programs worldwide and results in a huge number of new cultivars released every year. The primary combinations are formed by the diversification of the range of fruit types, with different quality characteristics and sensory qualities [14-16]. The differences in the physico-chemical contents of primary (sugars, organic acids, amino acids, and dietary fiber) and secondary metabolites (vitamins, terpenes, and phenolic compounds) [17,18] corroborate the qualitative attributes of the fruit. For example, combinations of soluble sugars (sucrose, fructose, glucose, and sorbitol) and organic acids (malic and citric acids) in varietal combinations are responsible for the sensory perception of sweet or sourness. In the meantime, phenolic compounds are the responsible factors for fruit sensorial-organoleptic attributes (flavor, aroma, and color pigmentation) [19,20].

1.2.2 Geographical Distribution of peaches:

From literature traces, it is predicted that peach was carried to west through India after starting from China to Persia via Mideast. Stone fruit producing countries include China, USA, Italy, Spain and Turkey [21]. In India, it is primarily grown in Jammu and Kashmir, Himachal Pradesh, Punjab, Uttarakhand, Nilgiri hills, Jharkhand and North Eastern States [22]. Peach is an important produce for the economy and one of the most popular fruits with a worldwide production of about 21.8 million metric tons in 2020–21 and a cultivated area of about 1.5 million Ha, worldwide. The popularity of the fruit is primarily due to its delicious flavor and attractive appearance. India has produced peaches in a total of 108150 tons in 2020-21[FAOSTAT 2021-22]. Peach is ranked as one of the five predominant and amply cultivated fruit in the same position with apple and peas [23].

1.3.1 Dietary Phytochemicals:

Phytochemicals are bioactive and non-nutritive secondary metabolites present in different parts of a plant. Plants contain a broad number of chemical substances that originate from evolutionary interactions with their environment [24]. Food elements like fruits, vegetables, whole grains, beans and nuts are found to have around 5000 phytochemical compound till date [25,26]. These dietary phytochemicals affect self and neighboring plants growth and physiological processes, attract pollinating insects and prevents herbivore predation as defense mechanism [27] [28]. The primary phytochemicals come under categories like carotenoids, phenols, nitrogen compounds, organic sulfur compounds and plant sterols [26]. Among these compounds, phenols are ubiquitous in different parts in a large no. of plants. The phenols are characterize with one or more hydroxyl groups in the structure and are aromatic organic acids. These compounds are categorized according to the number of phenol rings in phenolic acid, stilbene, flavonoid, and lignan [29]. Primarily found phenols in food products are phenolic acids and flavonoids especially hydroxycinnamic acid [30] [31]. P-coumaric acid, caffeic acid, ferulic acid and erucic acid are the hydroxycinnamic acid compounds under the cinnamic acid derivatives group of flavonoids abundantly present in the plant-based diets [26,29]. Flavonoids structure contains two benzene rings and a heterocyclic pyran ring connecting them together [32]. The pyran ring is the core of the structure and the arrangement of functional groups on it dictates the biological activity of the flavonoid compound [33]. Though among these activities anti-oxidant capacity does not differ much but the differences in their flavonoid bioactivities can be promptly noticeable and base of five categories: flavonols, flavonoids, isoflavones, flavanones, anthocyanins and flavanols. The structure level reasons for these differences are the substitution position, combination and number of hydroxyl groups on the basic skeleton [33,34]. The average intake of flavonoids like carotene, lutein, zeaxanthin and lycopene is 150-600 mg/day worldwide [35]. Many flavonoids like Catechins, organic sulfides such as allyl sulfide, indole and its derivatives, isothiocyanate and dithiophosphate, are present in garlic, alliums and cruciferous vegetables. Phytosterols can be many types like stigmasterol, sitosterol and campesterol which have similar structure with cholesterol [36,37].

1.3.2 Therapeutic effects of phytochemicals:

Phytochemicals of different classes like carotenoids, polyphenols, flavonoids, alkaloids etc. are bioactive in nature and express beneficial pathological effects for ranges of chronic diseases like diabetes, cardiovascular diseases, cancer, etc. and other medical conditions. From different dietary and other plant sources more than 5,000 phytochemicals have been identified. Over 5,000 phytochemicals have been discovered from various and other plant sources, yet there is still opportunity for research and knowledge expansion [26].

Human diseases are the results of numerous different causes and from them, genetic and environmental factors related conditions are of primary concern and also extensively studied. Metabolic factors of disease may include excessive amount of saturated fat containing diet, a high sugar diet ingested in a body system having very little or no activity and exercise. This condition may give rise to chronic diseases, such as cardiovascular disease, hypertension, diabetes, and fatty liver disease [38]. The intake of bioactive compounds in the form of plant-based diets might be helpful in reducing the occurrence of these metabolic diseases [39-41]. The primary metabolic pathway of free radicals that can result in a number of diseases and accelerated human aging is oxidative stress. The process of this occurrence is excessive production of free radicals may damage lipids, proteins and DNA caused by apoptosis, cell proliferation and ion transportation [42-44]. The non-enzymatic antioxidants includes small-molecule bioactive phytochemicals like carotenoids, phenols, flavonoids which can protect biological macromolecules from oxidative damage.

1.3.3 Peach Phytochemicals:

Extensive studies of the chemical components of *Prunus persica* have resulted in the identification of different classes of phytochemicals like phenolic acids, flavonoids, triterpenoids etc. Peach fruit is abundant in carotenoids (Provitamin A), ascorbic acid (vitamin C), and phenolic compounds that are great sources of antioxidants. Hydroxycinnamic acid is the primary phenolic compound derived from peach. Peaches contain generally phenolic acids like chlorogenic and neo-chlorogenic acids; the flavonols, quercetin and quercetin derivatives; the flavan-3-ols, catechin, catechin derivatives, and procyanidins; and small amounts of anthocyanins, cyanidin 3β-rutinoside and cyanidin 3β-glucoside, 3,5-di- O- caffeoylquinic acid, chlorogenic acid [CA], and ferulic acid [45]. Multiple phenolic acids, including protocatechuic acid hexoside, gallic acid hexoside, 3-p-coumaroylquinic acid, and some chlorogenic acid derivatives, hydroxycinnamic and hydroxybenzoic acids etc. are present in different parts of the plant [46]. Neo-chlorogenic acid, chlorogenic acid, gallic acid hexoside, 3-*p*-coumaroylquinic acid, cyanidin 3β-glucoside, protocatechuic acid hexoside,[47] protocatechuic, *p*-hydroxyphenyl acetic, *p*-hydroxybenzoic, *p*-coumaric, chlorogenic, catechin and ferulic acids are major phenolic compounds in kernels of peach [45]. The major phenolic compounds in peach kernel oil contains are dithiothreitol, rutin and caffeic acid [23]. A fragmentation study revealed that rutin, isoquercetin, quercetin, and hyperoside are flavonoid o-glycosides with the same aglycon (quercetin). Kaempferol shows an analogous structure to that of quercetin but with a missing –OH group at C-5′. Flavonols including derivatives of epicatechin such as (−)-epicatechingallate kaempferol-3-O-rutinoside, isorhamnetin-3-O-rutinoside, kaempferol-3-O-galactoside and isorhamnetin-3-O-glucoside are also available in a fraction in the peach sample [48].

Peach kernel oil contains unsaturated fatty acid and antioxidant components. The major fatty acids identified in peach kernel oil are about 58% oleic acid and 32% linoleic acid and a part palmitic acid [23]. The leaf oil composition is exclusively dominated by benzyl alcohol, benzaldehyde and ethyl ester benzoic acid as the primary components. Palmitic and stearic acids are the most exemplary saturated fatty acids in peach kernel oil and arachidic and myristic acids are only in traces [49].

1.3.4 Therapeutic Effects of Peach:

Many of the phytochemicals present in peach shows potential antioxidant, anti-inflammatory, anti-cancer etc. activity. Several groups [50-55] have investigated the phenolic compound concentration in *P. persica* in different stages of maturation. Studies showed that *P. persica* contains chlorogenic acid, catechin, flavonols, cyanidins etc. as important bioactive compounds. Peach kernel extract exerts anti-proliferative effect of on human colon cancer cells in vitro approach [56]. The study on the Chinese and South African origin fruit shows that the extract of may have a significant role in reducing cell viability, inhibit cell proliferation, induce morphological changes and affect cell cycle progression of the HT-29 human colon cancer cell line. It hypothesizes amygdalin and the presence of volatile oils, fixed oils and glycosides in the kernels to be responsible for the growth inhibition. A study by Saidani et.al. (2017) on peel showing high levels of caffeoylquinic acid derivative (HA5), chlorogenic acid (HA3), glycosides of quercetin (FO1, FO2) and kaempferol (FO3), (+)-catechin (FA2), ascorbic acid (AA), relative antioxidant capacity (RAC), total phenolic (TPC), flavonoid (FLA) and anthocyanin contents (ANT) [13]. The pulp can be defined by high levels of sucrose (SUC), glucose (GLU), fructose (FRU) and malic acid (MAL). Calanda Tardio samples, showed high levels of sorbitol (SOR), p-coumaroylquinic acid (HA2), chlorogenic acid derivatives (HA1, HA4) and lower levels of anthocyanin content (ANT), cyanidin-3-glucoside (ANT1) and quinic acid (QUI).*P. persica* flower extract can stimulate muscle contraction in animal model and it can be used for gut motility disorders like indigestion and constipation. This hypothesis was proved by performing prokinetic activity assessment of different *P. persica* flower extract and also found out its possible mechanism (Han et.al. (2014)). Ceccarelli et.al. (2016) characterized the phenolic compounds in exocarp (peel) and mesocarp (flesh) in some Italian peach cultivars by a HPLC-DAD-based analysis. The chlorogenic acid, flavonol (quercetin-3-O-rutinoside), Flavan-3-ols (catechin, epicatechin and procyanidin B1) concentration found to be more in exocarp than mesocarp [57]. Villanueva et.al. (2015) extracted and characterized the ACE-inhibitory peptides from *P. persica* stones [58]. Three gastrointestinal enzymes and ACE inhibiting peptides were identified and evaluated and showed potential antihypertensive effect. Kurz et.al. (2008) and Versari et.al.(2002) showed that both raw and canned *P. persica* inhibited low-density lipoprotein (LDL) oxidation [59,60]. And also Antioxidant activity protected 56–87% of the LDL. Protection was attributed to the hydroxycinnamic, chlorogenic and neochlorogenic acids in *P. persica*. Loizzo et.al. (2015) has studies the bioactive compounds in ethanolic extract of different parts of the plant [61]. From the study, Gallic acid, protocatechuic acid, protocatechualdehyde, chlorogenic acid, p-coumaric acid, and ferulic acid were identified as main constituents. Overall, the obtained results suggest that *P. persica* var. platycarpa displays a good antioxidant activity and its consumption could be promoted. Gasparotto et.al. (2013) performed antoxidant, anti-glycation and anti-inflammatory activities evaluation. The study concluded high antioxidant and anti-inflammatory effects [62]. *P. persica* has a potential effect on growth inhibition of liver cancer cell by inducing cell cycle arrest and migration suppression; as proved by Shen et.al., 2017 [63]. These studies prove that *P. persica* has many important bioactive compounds and they show promising effects towards anti-oxidant, anti-inflammatory and anti-cancer activity. Shirosaki et.al. (2012) showed that the Peach Leaf can inhibit glucose absorption in the small intestine in mice [64]. It contains Multiflorin A, a kaempferol as a potent glucose absorption inhibitor and thus proven to be anti-diabetic in nature.

Origin of *P. persica* cultivation in India goes to way back. Sarkar et.al. (2015) has listed it in suggested fruit for pitta type of body construction according to ayurveda, an ancient literature of India [65]. It is distributed in different parts like Assam, Madhya-Pradesh, Uttarakhand, Meghalaya, Maharashtra etc. Indian *P. persica* varieties have been evaluated primarily for its fruit quality assessment and wine making procedure [65-68]. Dhingra et.al. (2014) studied the antioxidant activities of different fractions (hexane, ethyl acetate, n-butanol and aqueous fractions) of *Prunus persica* fruit [69]. A positive correlation between phenolic, flavonoid contents and antioxidant activity can be seen in the extracts. The fruit has been obtained from Kullu, Himachal Pradesh, India. So it can be concluded that the Indian variety of *P. persica* shows high antioxidant activity and it gives a way to further analyze it for anti-diabetic, anti-inflammatory, anti-tumor activities in future.

1.3.5 Anti-inflammatory activity

Inflammation is an adaptive response triggered by noxious stimuli and conditions, such as infection and tissue injury [70]. A wide range of progressive diseases, including cancer, neurological disease, metabolic disorders and ALI, are associated with inflammation. Inflammation is regulated by an array of mediators including cytokines [71]. Macrophages, as the main pro-inflammatory cells, release various inflammatory cytokines such as tumor necrosis factor- α (TNF-α), interleukin-6 (IL-6) and interleukin-1β (IL-1β), and other inflammatory mediators, such as nitric oxide (NO) and prostaglandin E2 (PGE2) upon activation by bacterial products such as LPS [72] [73]. Suppressing the expression of these pro-inflammatory mediators and cytokines, therefore, could ameliorate the inflammatory diseases [74].

Over the years, many natural compounds were used as templates for the development of new anti-inflammatory agents. Plant phenols, particularly flavonoids, feature a wide range of biological activity, mainly including antioxidant and anti-inflammatory activity, useful as alternative medicaments [75]. Many studies highlighted that different phytocomplexes derived from *Prunus persica* are endowed with multiple biological activities, including antioxidant and anti-inflammatory activity, which were studied in different experimental models. The cytokines TNF-α and IL-1β trigger pro-inflammatory signalling in tissues escalating reactive species production and promote cytokine expression and release. In reaction to acute or chronic infection, these cytokines' yield and release are increased. Therefore, ELISA quantification of TNF-α and IL-1β measured in the incubation medium has been the method to analyse the potential anti-inflammatory properties of peaches on tissues [76,77]. Gasparotto et al. (2014) found that when kidney, liver and brain cortex tissues were preincubated (subjected to oxidative stress with $FeSO_4$ and H_2O_2) with fresh peach pulp and peel rendered better protection against cytotoxicity as compared to the preserved peach pulp in the various tissues [62].

1.3.6 Anticancer activity

Flavonoids like quercetin 3β-glucoside and procyanidin fraction of peach phytochemicals have potential effect on breast cancer cell lines. Specifically, neo-chlorogenic and chlorogenic acids show potential as chemo preventive dietary compounds since they expends relatively high growth inhibition on the estrogen-independent MDA-MB-435 in breast cancer cell line and low toxicity imposed on the normal MCF-10A cells [78].

The protection against cisplatin-induced hepatotoxicity effect in animal models by the ethanol extract of *P. persica* flesh (PPFE) was evaluated. Cisplatin (*cis*-diamminedichloroplatinum II) is among the most functional chemotherapeutic agents applied in the treatment of a range of human solid tumours. Although, its pharmaceutical use is narrowed down due to acute toxicity causing oxidative liver damage. Furthermore, in cisplatin-treated mice, oral treatment of PPFE had a substantial favourable influence on decreased glutathione levels and prevented lipid peroxidation [79]. An *in vitro* study on the anti-proliferative effect of extracts from peach kernel on human colon cancer cells was also studied by Cassiem and Kock (2019) [56].

1.4 Analytical Methods:

1.4.1 Phytochemical Extraction Methods

Several efforts have been made to extract the phytochemicals from different sources at different point of time since their therapeutic effects came to light. The effectiveness and efficiency of the stated extraction procedures are crucial in extracting bioactive components from a variety of food/agricultural sources. Bioactive compounds have been extracted from numerous natural sources using both traditional and sophisticated extraction procedures [80]. Being a widely used fruit, peach has also undergone many such extraction techniques time and again. Sample preparation and extraction methods widely vary according to the types of compounds and yield.

Solvent extraction methods are the most convenient and widely used procedures due to their feasibility, efficiency, and wide usability. The yield from the chemical extraction process largely depends on the type of solvents with different polarities and conditions like extraction time and temperature, sample-to-solvent ratio etc. Primarily, acetone is found to be the best solvent for extracting tannins and proanthocyanidins; ethanol extracts flavonoids and their glycosides, catechols and tannins efficiently; while methanol extracts phenolic acids and catechin better [81].

The extraction of total phenolic compounds from peach fruit are done using different solvents (methanol, ethanol, acetone and water), solvent acidity (0–2 N), concentration (20–100%, v/v), temperature (25–70 °C) and time (30–450 min). The best extraction conditions studied to be of 60% acetone for 180 min without acidification at 25°C gave 363 GAE/100g total phenolic content [48].

Peach fruit and other parts of the plant have been extracted using various methods from different germplasms around the globe viz., USA [82], Italy [83], Spain [84,85] and Brazil [86]. The pigmented (anthocyanins) and non-pigmented phenolic constituents of six peach cultivars (e.g., Summer Rich, Royal Lu, Fidelia, Royal Magister, Royal Glory and Sweet Dreams) were evaluated from the region of Fundão (Covilhã, Portugal) [87]. They used ethanol as a solvent in 7:3 ratio having 30 min of stirring followed by 15 min of centrifugation at 2900 g and reported the total amounts of non-pigmented phenolics ranging from 221.2 µg/g (Summer Rich) to 1288.1 µg/g (Royal Lu) of lyophilized fruit ($P < 0.05$).

Some novel advanced methods have also been employed in peach phytochemical extraction. Zhao et al. (2015) used an ultrasound extraction system to extract 17 Chinese peach cultivars [88]. They used an ultrasonic frequency of 60 kHz and 30 W power and an 80% methanol solvent system for 30 min followed by 8000 rpm centrifugation at 4 °C for 10 min and evaluated for phenolic content. Some authors have also used ultrasound-assisted extraction (UAE) for efficient extraction of phytochemicals [89,90]. In addition, Adil et al. (2007) used a subcritical (CO_2+ethanol) polyphenol extraction method and Ekinci et al. (2014) used supercritical fluid extraction on seeds of *Prunus persica* [46,91]. Conventional extraction techniques (centrifugation, steam distillation and Soxhlet extraction) possess some drawbacks due to the use of high temperatures and/or high amounts of organic solvents; another limitation is that the steam distillation process can be used only to obtain volatile oils (mostly terpenes) [92]. The extraction method, solvent polarity, and extraction time all have a substantial effect on effective polyphenols extraction. Like other environmental friendly extraction processes of bioactive compounds, using microwave-assisted extraction (MAE) as a green eco technological technique has gathered an important research interest recently [93]. Ionic conduction (movement of charged ions) and dipole rotation (reversal of dipoles) are the two mechanisms which reduces solvent requirement and the extraction time in MAE and results in the reduction of the process environmental footprint [94].

1.4.2 Separation and quantification methods

The separation of phytochemical compounds from one another results in the phytochemical profile of the sample. Different chromatographic techniques have been used from the initial time to recent studies for this purpose. It is well known that quantification by using liquid and/or gas chromatography techniques is the most general and widely followed for the analysis of phenolic acids and flavonoids in fruits and vegetables. Furthermore, nonspecific methods (e.g., spectrophotometric assays) are also applied to evaluate the phenolic levels in varieties of vegetables and fruits.

Gas chromatography-mass spectroscopy is the common method for fractionation and detection of phenolics present in peach extract [48,95]. Simultaneously, thin-layer chromatography (TLC), column chromatography, capillary gas-liquid chromatography [96] etc. have also been used to serve the purpose [97] [98].

1.4.3 Computer-aided drug designing:

Computer-aided tools have emerged as advanced methods for drug discovery, which can be applied to screen the drugs from phytochemicals found in various medicinal plants [99]. Computational prediction models, also known as predictive tools, which play an important part in the selection of methodologies directing pharmaceutical and technological research, and have also been used in *in silico* prediction of pharmacological, pharmacokinetic and toxicological performance [100]. Molecular docking and *in silico* calculations are simulation-based approaches that could be used in systemic study by introducing a molecule on the binding spot of the object macromolecule in a non-covalent fashion, leading to an accurate binding at the active sites of each ligand [101] [102]. These methods help to save time and are cost-effective, while performed in prior to in vivo and in vitro studies. Molecular dynamics assay also provides valuable information about the structure, dynamics, and interactions of biological macromolecules [103].

1.4.4 Encapsulation of phytochemicals

The phytochemicals present in fruits and vegetables can be directly incorporated as such into food for product development. However, several limitations may arise while incorporating extracted bioactive compounds directly into food products, such as their susceptibility to oxygen, enzymes, pH, light, temperature, and low stability [104,105]. Additionally, phytochemicals, particularly polyphenols naturally have an astringent flavour that could hinder or mask food product's overall sensory appeal. To incorporate the plant extracts into a food product and get their profits, it is necessary to resolve the technological challenges related to sensory or stability [106]. Microencapsulation serves as a modern embedding technique where microcapsules encapsulates the bioactive materials as a delivery medium that isolates the bioactive compound from an undesirable environment until it is released upon exposure to the desired stimulus [107]. Polysaccharides such as maltodextrin, gum arabic, cellulose, chitosan, modified starch, etc., and proteins like soybean protein, corn zein, whey protein, sodium caseinate, etc., are frequently utilised in microencapsulation encapsulating agent because of their excellent stability, availability, and encapsulating ability [108-110]. The solution generated by dissolving sodium alginate in water possesses softness, homogeneity, and other great properties that are challenging to get from other counterparts like arabic and xanthan gum [93]. Sodium alginate contains strong hydrophilicity and can be dissolved in water to form a very viscous and homogeneous solution. It boosts the gel's viscosity, shields the drugs and bioactive compounds from gastrointestinal enzymes and acid, and improves its bioavailability [111]. The microencapsulated beads resulted from the gelation of Ca^{2+} ions with sodium alginate, are used in a variety of applications where they are meant to swell and release the compounds in the near-neutral intestinal environment while remaining intact in the acidic gastric environment [112,113].

1.4.5 Incorporation of phytochemicals in a food product

Functional foods are natural or industrially processed food products that, when regularly consumed at satisfactory levels in a diversified diet, have positive health effects beyond basic nutrition. The concept describes functional foods as products containing biologically active compounds in effective and non-toxic quantities, derived from natural or processed food sources, and clinically tested, based on specific biomarkers, providing health benefits for prevention, management or treatment of chronic diseases or their symptoms. The primary and most popular peach products are syrup (canned or glass vessels) and concentrated peach purée. The purée later on is used as a starting ingredient for formulations like baby food, juice, jams, pulp and yogurt [114]. Since all the nutrients are concentrated in one product, fruit leathers are a cost-effective and convenient alternative to fresh fruits with superior nutritional properties (particularly in terms of minerals, antioxidants, fibers, and energy) [115]. Various fruit leather products are developed and are made available commercially, like mango leather, guava leather, banana leather, grape leather, apricot leather, jackfruit leather and Roselle fruit leather [116-118].

1.5 Hypothesis

We hypothesized that from the research work,

- The bioactive compound contents of Norabogori fruit will be explored
- Norabogori fruit extract with high content of phytochemicals will be obtained exhibiting anti-oxidant activity
- Norabogori extract will have anti-cancer activity
- Functional food product from 'Norabogori' (*Prunus persica*) fruit of Assam will have Anti-inflammatory property

1.6 Gap of research

The peach fruit has been reported for its medicinal properties in different countries. It is shown to contain important phenolics like hydroxycinnamate, chlorogenic acid; varied flavonols, Flavon-3-ols, anthocyanins, pro-cyanidines, banzaldehydes etc. It has been proved that the phenolic compounds possess physiological properties favoring our organism's antidiabetes, antiallergenic, antimicrobial, antithrombotic, anti-inflammatory, anticarcinogenic, antihypertensive, and antiarthritic effects, especially that they behave as powerful antioxidants that protect our body against the deleterious effects of oxygen. Previous studies investigating the phenolics' profile of *P. persica* have concluded that cultivars have differences in their phenolic profiles and antioxidant properties, which highlight the importance of studying the variation of bioactives across commercially important cultivated varieties. Some studies have been done on Indian *P. persica* variety for its quality assessment, but not for its phytochemical profile or any disease related characteristics. So, to meet the discrepancy of knowledge, the proposed project is an initiative to fill the gap with the exploration of *P. persica* based bioactive compounds from locally available variety in Assam, for their anti-inflammatory characteristic. The positive result may guide us to increase the intake of *P. persica* for disease prevention. Processing and in-vitro studies of the molecule will ensure its bioavailability. The value addition of the fruit product will promote its production, consumption, and commercialisation.

- There has been very little to no work on norabogori, a peach variety of Assam exploring its phytochemical profile or any disease related characteristics.

- The scientific mechanism and specific phytochemical responsible for the anti-inflammatory activity of norabogori extract has not been reported.
- Anti-cancer activity of norabogori fruits have not been evaluated.
- Norabogori fruits or its product has not been commercialized based on its health benefits.

1.7 Objectives

1. To extract bioactive compounds from the fruits of Norabogori (*Prunus persica* L. Batsch) and their quantification and characterization
2. To study the *in vitro* anti-inflammatory and anti-cancer activity of the norabogori extract
3. To study the *in silico* anti-inflammatory activity of the norabogori extract

   a) To characterize and evaluate the drug likeliness of extracted bioactive compounds from Norabogori

   b) To evaluate the potential anti-inflammatory bioactive compounds by molecular docking study
4. To develop functional food product by incorporating encapsulated Norabogori extract

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