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Original article

Characterization of indigenous phalsa (*Grewia subinequalis*) genotypes using morphological traits and ISSR markers

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ABSTRACT

Background: Phalsa (*Grewia subinequalis* L.) is a commercial and nutritionally important berry fruit. It is cultivated in Pakistan as a minor fruit crop without any variety characterization. Therefore, the objective of to assess genetic diversity through ISSR markers and morphological features of wild phalsa genotypes collected from different parts of Punjab, Pakistan.

Methods: Morphological characteristics such as plant height, stem circumference, growth habit, leaf length, leaf width, leaf area, leaf color and leaf apex shape showed high variation among genotypes.

Results: Among the twenty inter-simple sequence repeats (ISSR) primers, UBC-812 exhibited the highest PIC values of (0.485) and Dj (0.389) compared to other primers, which considered it better for the identification of phalsa genotypes and prediction of diversity. Moreover, the unweighted pair group method with arithmetic mean cluster analysis divided the sampled genotypes into five clusters (clusters A-E) based on morphological analysis, while molecular data divided the genotypes into eight clusters (clusters A-H).

Conclusion: This study confirmed the high diversity in wild populations especially 'O1P2" and "O7P3" genotypes, with both DNA-based and morphological descriptors that depict their potential use for future phalsa breeding programs.

1. Introduction

Grewia asiatica, commonly known as 'phalsa', is a minor fruit crop native to south Asia and widely cultivated in tropical and subtropical regions (Chundawat and Singh, 1980). Phalsa is an excellent source of antioxidant, antidiabetic, antihyperglycemic, hepatoprotective, radioprotective, antimicrobial, antipyretic, antifungal, analgesic, and antiviral compounds (Zia-ul-haq et al., 2012; Jyoti et al., 2015; Sinha et al., 2015). In particular, the leaves are a source of fodder for cattle and are applied to treat wounds,

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Genotypes and harvest maturity influence the nutritional fruit quality of mulberry

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ABSTRACT

Higher water content and delicate fruit texture of mulberry limit its postharvest shelf-life with poor eating quality. Therefore, the current study was planned to evaluate fruit quality characteristics of four mulberry genotypes ("Black short", "Black long", "Chinese white" and "Chinese long") harvested at two maturity stages (Semi ripe and ripe). Among different genotypes, the fruit of Chinese long exhibited significantly higher fruit length, fruit weight, number of drupelets, juice weight, total soluble solids (TSS), ascorbic acid, moisture and ash content. The maximum ripening index (TSS/TA), juice pH, antioxidant scavenging activity (ASA) and catalase (CAT) were found in Chinese white. However, Black short showed the higher value of fruit diameter, dry matter, titratable acidity (TA), total phenolic contents (TPC), protein, carbohydrates and peroxidase activity (POD). The highest superoxide dismutase activity (SOD) was observed in "Black long". As the maturity advanced, fruit diameter, fruit weight, juice weight, TSS, TSS/TA, TA, ascorbic acid, ASA, TPC, moisture and fat content showed an increasing trend from Semi ripe to Full ripe stage while dry matter, pH, ash, protein, carbohydrates, and activities of antioxidative enzymes (POD, SOD, and CAT) showed the reverse trend. In conclusion, Chinese long genotype at a fully ripe stage exhibited the best fruit quality attributes with higher nutritional values.

1. Introduction

Mulberry (*Morus alba*), a minor fruit crop, belongs to the family Moraceae (Sánchez-Salcedo et al., 2017). *Morus* is considered as a complex genus, comprising numerous species (Ercisli and Orhan, 2007; Gunes and Cekic, 2004; Huo, 2002) with 100 known varieties (Ercisli and Orhan, 2007). In Pakistan, four different mulberry species have been reported which are named as short (*M. alba* and *M. nigra*) and long mulberry (*M. macroura* and *M. laevigata*) (Mahmood et al., 2017). According to the statistical data, it is cultivated in an area of 827 ha, with an annual production of 1804 tons of fruits (MNFSR, 2018).

It is much appraised as highly nutritive fruit crop, consumed in fresh and dried form, processed in jams, marmalades, jellies, juices, liquors, natural dyes, and cosmetics industries (Ercisli and Orhan, 2007; Imran et al., 2010). The dark fruits are a unique source of phytochemicals and phenolic compounds. Fruits of *Morus nigra* L. are slightly acidic and quite dark in colour, correlated with a high anthocyanin content, which plays a significant role in pharmacological and food industries (Behlil et al., 2019; Gündeşli et al., 2019; Okatan, 2018). During the last decade, its production and consumption have increased tremendously as people got awareness about nutritional and functional quality characteristics of mulberry fruit (Hu et al., 2014).

Mulberry is a non-climacteric fruit, therefore, it is important to harvest it at a proper mature stage for good nutritional quality, shelf-life, and market value. Fruit maturity in mulberry is usually judged by appearance, texture, and color (Mahmood et al., 2017). The harvested fruits include a mixture of unripe (green) and ripe (white, red or black) fruits due to alternate ripening pattern and unripe fruits are discarded during processing in industries (Yang et al., 2016). Moreover, the chemical composition and nutritional status of mulberry fruits greatly vary with cultivars/genotypes, environmental conditions, harvest maturity and postharvest processing (Mahmood et al., 2017). Hence, there is the scope of selection and identification of genotypes harvested at proper maturity stage having best fruit quality characters including optimum fruit size, better taste, high nutritive profile (Okatan et al., 2016) to meet nutritional demand of consumer and for alternative use

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Original Research

Changes in Physico-Chemical and Sensory Fruit Quality Attributes of Apricot during Ripening

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ABSTRACT

Varietal variation in apricot causes differential changes in fruit quality during ripening. A study was executed to evaluate the effect of apricot varietal variation on fruit physico-chemical and sensory attributes during fruit ripening. Fruits of two apricot cultivars, 'Old Cap' and 'Red Flesh' obtained from Baluchistan were monitored at ambient conditions (25 ± 2 °C and 60-65% RH) during fruit ripening for physico-chemical and sensory attributes. Irrespective to days at shelf during fruit ripening, fruits of 'Red Flesh' apricot exhibited significantly reduced fruit weight loss with greater fruit firmness, total soluble solids (TSS), total phenolic content (TPC), ascorbic acid and antioxidant scavenging activity (ASA) than 'Old Cap' apricot fruits. However, titratable acidity (TA) of 'Old Cap' apricot fruits remained significantly higher than 'Red Flesh' apricot fruits during ripening. At eating soft stage, sensory attributes including fruit pulp colour, taste, flavour and overall acceptability of 'Red Flesh' apricot fruits were superior to 'Old Cap' apricot fruits. In conclusion, 'Red Flesh' apricot showed better fruit physico-chemical attributes during fruit ripening and fruit sensory attributes at eating soft stage than 'Old Cap' apricot fruits.

Keywords: *Apricot phenology, fruit size, Prunus armeniaca, shelf life, total phenolic content.*

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INTRODUCTION

Apricot (*Prunus armeniaca* L.), a stone fruit with soft and fleshy mesocarp belongings to *Rosacea* family, is generally grown in the Northern Hemisphere, the Mediterranean and Central Asian regions contributing more than 80% of the world's apricot production. It is cultivated in more than 40 countries throughout the temperate regions of the world (Chadha, 2003). Turkey, Uzbekistan, Algeria, Iran and Pakistan are the leading apricot producing countries. Pakistan ranks at 5th spot in the world apricot fruit production, contributing about 23% of world's total apricot production (FAOSTAT, 2018). Within the country, Baluchistan province shares most of the apricot fruit production, which is about 93% of the country's total production. Baluchistan province is also the home of very diverse apricot genotypes. According to a report, most of the apricot commercial cultivars of the country (about 60 types) are being grown in the province (Anonymous, 2018). As for as the nutritive value of apricot is concerned, it is a rich source of phenolics, phytochemicals, antioxidants, and carotenoids, that are considered important for human health (Lichou et al., 2003). Despite the huge production, the country did not rank in top apricot exporters due to enormous postharvest losses pertaining to high perishable nature of the fruits. Moreover, apricot has a limited postharvest life at ambient conditions experiencing rapid fruit ripening and deterioration after harvest (Yan et al., 2017). Postharvest fruit related changes are dependent on type of cultivar, storage conditions, and management strategies including packaging and pre-and postharvest treatments of ripening delaying chemicals alone and in combination with low temperature storage. After harvest, potential shelf life, sensory characteristics (flavour, aroma) and nutrient composition are greatly influenced by apricot genotypes (Bureau et al., 2006). Therefore, during ripening, fruits of individual cultivar must be observed for changes, because fruit ripening pattern in one cultivar may not be applicable to other cultivars within the same species (Goulao and Oliveira, 2008). Previously, the traditional attributes like fruit appearance, sugars and organic acids had been studied in relation to fruit quality in different apricot cultivars during on-tree ripening stages (Drogoudi et al., 2008; Piagnani et al., 2013; Iordanescu et al., 2018) and after harvest during fruit ripening (Bureau et al., 2006). Locally no work on apricot has been reported to address cultivar dependent response during fruit ripening. However, only scanty work on fresh and dried apricots has been reported (Ali et al., 2011; Hussain et al. 2015), which was not focused on postharvest fruit quality of contrasting cultivars during fruit ripening. The reported work is limited to commercial apricot cultivars of Gilgit Baltistan (GB) region of the country, which only shares a small proportion of Pakistan's total apricot production. So, the current study was executed to

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Research Article

Polyphenols, alkaloids and ethanol extracts from medicinal plants in treatment of cancer

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Abstract
The fundamental purpose of this review article is to bring forth discussion, summary, evaluation, and conclusion of treating cancer with medicinal plants. Cancer is amongst the most life-threatening diseases which dates back all the way to 1600 B.C. Cancer is a dangerous disease that mostly is caused when a part of human body witnesses uncontrolled division within the abnormal cells that slowly dismantle that particular body part's function until it spreads to death. With latest technology advancement in the medicine, scientists, doctors, and researchers have gathered legitimate facts of plants that could not only provide essential treatment but also help in future eradication of this disease. This review article consists of researches of theoretical, mathematical, and practical nature. In lieu of random cancer treatment approach, certain chemicals such as Polyphenols, Alkaloids, and ethanol will specifically be discussed throughout the paper followed by their possible extracts from medicinal plants. Furthermore, profound review of evaluation of antioxidant, anti-inflammatory, and properties of anti-cancer with medicinal plants will be discussed along with how it is utilized in the conventional medication production.

Keywords: Cancer, Medicinal Plants for Cancer, Polyphenols, Alkaloids, Ethanol

Introduction
There are numerous medicinal plants found in abundant quantity on our planet. Scientists and researchers are on a surge to find and come up with advanced ways to utilize plants for the cure of various diseases. Considering Cancer for instance, has been in existence for quite some time and has become a rarely treatable disease.
Chemical entities such as Alkaloids, Polyphenols, and ethanol have shown promising results over the time in regards of treating cancer. These are also called antioxidant compounds which are found in ample quantity in fruits and vegetables. According to several studies, flavonoids, lignins, and tannins (all phenolic compounds) along with vitamins A, C, E can easily be found in plants as antioxidants.
Since fruits and vegetables contain health benefits and more nutritional value which is good for the human body, medicinal plants have become prominent entity in today's medicine. Antioxidants carry ability to lessen and control the digestive damage (oxidative) by simply suspending the ROS (reactive oxygen species) that causes inhibiting oxidation in the body. Phenolic compounds such as Ascorbic acid and Beta Carotene are also being used widely around the world to reduce inflammation and Cancer probabilities.
This review article comprises of previous and latest researches made on the topic of

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Nutritional functions and antioxidative enzymes in juice extract from two different maturity stages of low temperature stored phalsa (*Grewia subinaequalis* D.C.) fruit

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ABSTRACT

Phalsa is an important berry fruit in Asia, but little is known of its postharvest characteristics and especially changes in fruit composition during storage. Investigations were made for nutritional and antioxidative enzymatic changes in the juice extracted from two different maturity stages (M_1: pink to red or M_2: dark red to purple) during low temperature storage for 0, 2, 4, 6, 8 and 10 days at 5 ± 1 °C and 65 ± 5% RH. The fruit showed significant gradual declines in ascorbic acid (Vitamin C), total phenolics (TPC), total antioxidant capacity (TAC), total carotenoids, anthocyanins, moisture%, crude protein, crude fiber and fat content and the activity of superoxide dismutase (SOD) during storage. However, the total soluble solids (TSS), pH, ash content, and the activity of catalase (CAT) and peroxidase (POD) increased significantly. The polynomial regression analysis indicated that these changes were either quadratic or linear; and the Pearson's correlation among the studied parameters was significant. More mature fruit had higher concentrations of TSS, ascorbic acid, TPC, TAC, total carotenoids and anthocyanins, more juice and less weight-loss compared with less mature fruit. Overall, significant nutritive functions and antioxidative enzymes were found in both maturity stages of phalsa fruit, which experienced significant changes during postharvest storage.

1. Introduction

Phalsa (*Grewia subinaequalis* D.C., Tiliaceae) is a berry fruit that is native to South East Asia and the Indian sub-continent and is cultivated in South Asian countries including Pakistan, India, Nepal and Bangladesh (Khan et al., 2019). It can also grow well in South Asian tropical and subtropical regions such as Laos and Cambodia, the Luzon area in Philippines, central and north Thailand, and some areas of the USA (Yadav, 1999). The plant has a bushy, indeterminate growth habit (Kumar et al., 2014) of up to 4–5 m, and with large, slim and drooping branches. The broad heart-shaped leaves are about 5–18 cm long (Jyoti et al., 2015), with small sized orange to yellow coloured pentamerous flowers (Tripathi, 2016) and non-climacteric crimson red to dark purple fruits (Paul, 2015). Illustration 1 indicates the vegetative and reproductive morphology of phalsa.

Phalsa is a commercially significant plant. It has high drought resistance (Dave et al., 2016), and high nutritive and medicinal value (Mishra & Deen, 2017). The fruit is consumed fresh, and processed into juices (Paul, 2015) jams, and squashes (Zia-Ul-Haq et al., 2013). It is enriched with carbohydrates, fats, citric and malic acids, proteins, vitamins, minerals, antioxidants, flavonoids, carotenoids and anthocyanins (Tripathi, 2016). According to (Abid et al., 2012) the fruit may be useful for gastro-intestinal, skin, liver, heart and throat diseases and has been reported to possess anti-carcinogenic properties (Vyas et al., 2016).

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