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Research Article

BIOCHEMICAL ANALYSIS OF CABBAGE (*BRASSICA OLERACEA*) AFTER INFECTION OF PEST

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ABSTRACT
Plants of Brassicaceae family include worldwide commercially grown crops. Experiments on this crop were conducted during the year 2011 in Vidhania and Jaisinghpura of Jaipur district Rajasthan, India. The aim of this study is to find out primary metabolites like chlorophyll, sugar starch protein total phenol of cauliflower. Levels of plant metabolites are strongly affected by genetic and environmental factors. Growth factors such as light, temperature, humidity, type of soil, application of fertilizers, damage caused by microorganisms and insects, stress induced by UV radiation, heavy metals and pesticides all alter metabolite composition of plants. Different types of pests' cause changes in plant metabolite production. The results revealed the evidence of different infestation of cabbage by common herbivores. In this review we report primary metabolites of the cabbage along with the quantification after the pests' effect.
Keywords: Brassicaceae, cabbage, fertilizers, humidity, primary metabolites.

INTRODUCTION

Vegetables contain essential components of human nutrition. Nutrients have traditionally been viewed as food components that either cannot be synthesized in the body (for example, vitamin C) or whose synthesis requires a specific factor that may in certain circumstances be absent or inadequate (for example, some amino acids, fatty acids, and vitamins). However, there is now recognition that many other compounds of plant food, such as dietary fibre, flavonoids, sterols, phenolic acids, and glucosinolates are associated with lower disease risk. This has been widely reported, sometimes erroneously, by the popular press. Nevertheless, a large number of phytochemical capable of antioxidant, anti mutagenic, cytotoxic, antifungal, and antiviral activities have been identified in broccoli, cauliflower, Brussels sprouts, turnips, kale, mustard, asparagus, spinach, lettuces and endives[1,2]. The links between fruit and vegetable consumption and protection against cancers of stomach, oesophagus, lung, pharynx, endometrium, pancreas and colon have also been extensively reported[3,4]. These phytochemicals have been linked to many positive effects on human health, including coronary heart diseases, diabetes, high blood pressure, cataracts, degenerative diseases and obesity[5,6]. Brassicaceae family plants are the most popular vegetables consumed all over the world and considered to be a good source of bioactive phytochemicals. Cabbage is a good source of beta-carotene, vitamin C and fibre. It is a cruciferous vegetable and has been shown to reduce the risk of some cancers, especially those in the colorectal group. This is possibly due to the glucosinolates found in Cole crops, which serve as metabolic detoxicants or due to the sulphoraphane content, also responsible for metabolic anti-carcinogenic activities. Purple cabbage also contains anthocyanins, which in other vegetables have been proven to have anti-carcinogenic properties[7]. Along with other Cole crops, cabbage is a source of indole-3-carbinol, a chemical that boosts DNA repair in cells and appears to block the growth of cancer cells[8]. Research suggests that boiling these vegetables reduces their anti-carcinogenic properties[9]. Additionally, these species and varieties are increasingly becoming a research model in plant science, as a consequence of the importance of their primary and secondary metabolites. Plant interaction with environmental stress factors including animals and insects' herbivore, pathogens, metal ions, light, among others, is known to lead to the activation of various defence mechanisms resulting in a qualitative and/or quantitative change in plant metabolite production. Pre-harvest and/or post-harvest conditions are also known to affect this, since plants produce signalling molecules (e.g. salicylic acid, jasmonic acid etc.), that cause a direct or indirect activation of metabolic pathways. That ultimately affects the production of phytochemicals, such as carbohydrates (sucrose and glucose), amino acids, phenolics (phenylpropanoids and flavonoids) and glucosinolates. These phytochemicals have diverse applications due to their antimicrobial, antioxidant and anticarcinogenic properties, but on the other hand these compounds or their breakdown products can act as anti-nutritional factors in diet. Primary metabolites, for example; sugars, proteins, lipids, and starch are of prime importance and essentially required for growth of plants[10]. Nutrient composition of vegetables is very complex and difficult to assess. Levels of plant metabolites are strongly affected by genetic and environmental factors as well as transportation and storage conditions. Growth factors such as light, temperature, humidity, type of soil, application of fertilizers, damage caused by microorganisms and insects, stress induced by UV radiation, heavy metals, and pesticides all alter metabolite composition of plants[11]. Plant primary metabolism, which is shared with insects and other living organisms, provides carbohydrates, amino acids, and lipids as essential nutrients for the insect. Most of the insects considered common vegetable pests undergo a developmental process known as metamorphosis, which simply means that the insect changes form during its life. Metamorphosis may be complete or incomplete. Complete metamorphosis consists of four stages-egg, larva, pupa, and adult. Vegetable parts chewed by the insects this processes is known as herb ivory. Pest and insects are also affecting the primary metabolites of vegetable plants. Pest of vegetables is also reduces the quality of food. Food quality is largely determined by the availability of these nutrients (protein sugar carbohydrates) and its importance for longevity, size, fecundity, and death rates in herbivorous insects has been recognized early on by Painter[12].

Table 1: Various Primary Metabolites in Pest Free Vegetable Parts

Primary metabolites	leaf	Stem	Root
chlorophyll a	6.03±0.31 gm/gdw	2.17±0.41 gm/gdw	0.00 gm/gdw
chlorophyll b	6.11±0.53 gm/gdw	2.82±0.63 gm/gdw	0.00 gm/gdw
carotenoid	3.51±0.18 gm/gdw	1.05±0.44 gm/gdw	0.34±0.6 gm/gdw
sugar	4.00±0.65 gm/gdw	2.93±0.43 gm/gdw	2.00±0.49 gm/gdw
starch	6.00±0.56 gm/gdw	4.08±0.13 gm/gdw	3.25±0.35 gm/gdw
proteins	69.57±0.56 µg/mg	70.52±0.25 µg/mg	61.01±0.57 µg/mg
Total phenol	86.14±0.56 µg/mg	80.78±0.35 µg/mg	79.18±0.34 µg/mg

Table2: Various Primary Metabolites in Pest Infected Vegetable Parts

Primary metabolites	leaf	Stem	Root
chlorophyll a	4.14±0.3 gm/gdw	1.38±0.4 gm/gdw	0.00 gm/gdw
chlorophyll b	5.78±0.34 gm/gdw	2.82±0.23 gm/gdw	0.00 gm/gdw
carotenoid	1.71±0.81 gm/gdw	1.57±0.43 gm/gdw	1.28±0.16 gm/gdw
sugar	4.98±0.46 gm/gdw	3.15±0.14 gm/gdw	4.27±0.37 gm/gdw
starch	5.07±0.43 gm/gdw	2.34±0.32 gm/gdw	1.32±0.95 gm/gdw
proteins	72.65±0.53 µg/mg	87.34±0.32 µg/mg	76.42±0.11 µg/mg
Total Phenol	98.87±0.7 µg/mg	87.28±0.4 µg/mg	88.97±0.19 µg/mg

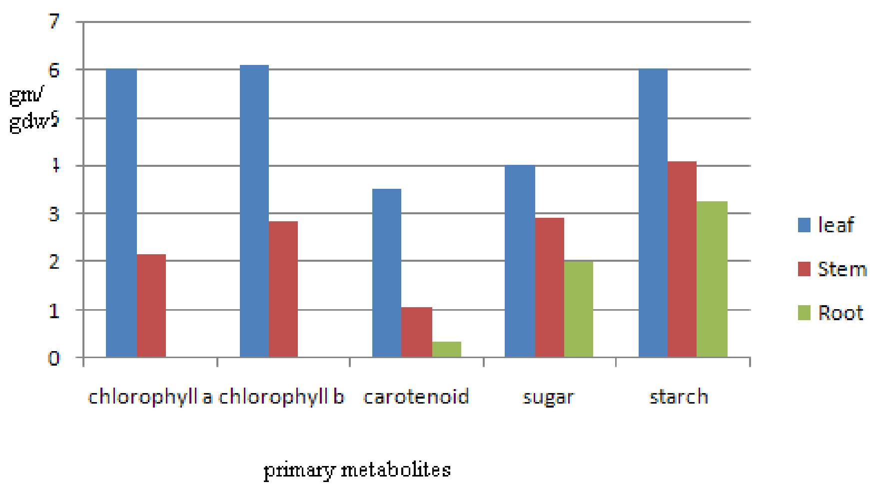

Figure 1: Primary metabolites of fresh cabbage

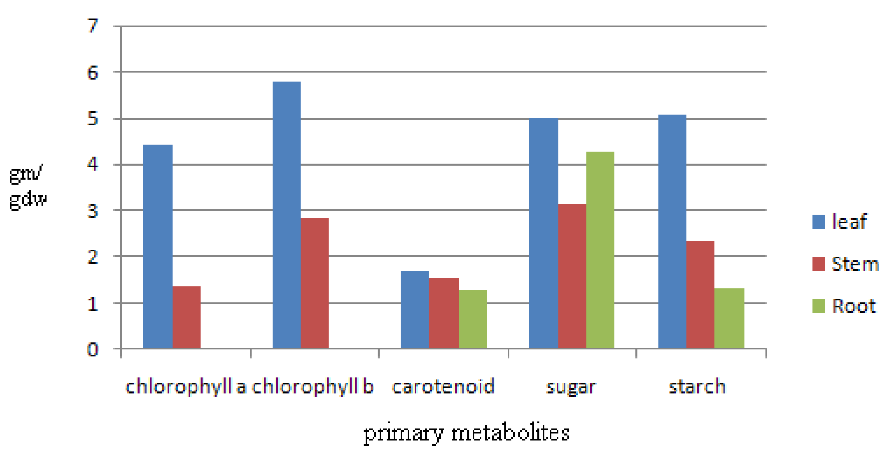

Figure 2: Primary metabolites of pest infected cabbage

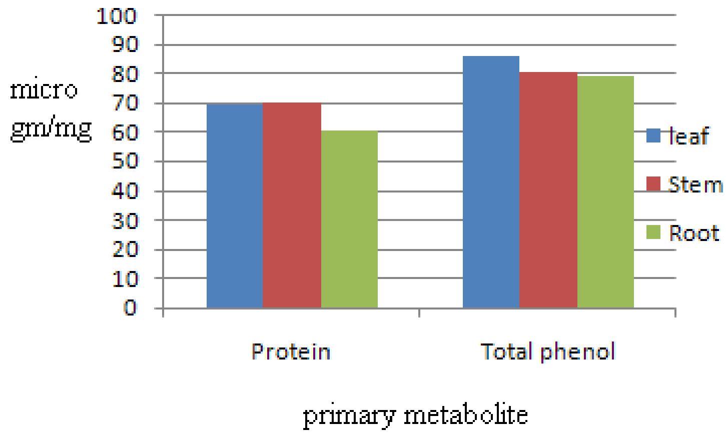

Figure 3: Protein and Phenol content of fresh cabbage

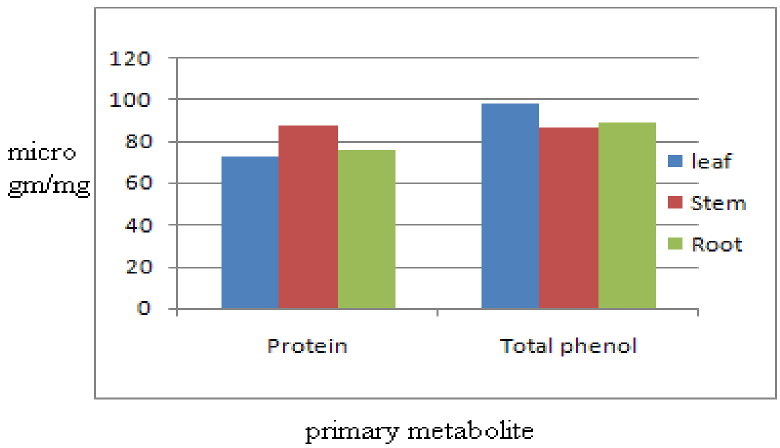

Figure 4: Protein and Phenol content of pest infected cabbage

Numerous studies have shown that herbivore causes large-scale changes in gene expression[13-20]. In this article we report primary metabolites of the Cauliflower along with the quantification after the effect of pests like cut worm white fly diamond back moth flea beetles cabbage lopper etc.

MATERIAL AND METHODS

Collection of plant material

Vegetable sample were collected from Vidhania and Jaisinghpura khor village of Jaipur districts Rajasthan, India. Fresh cabbage and pest infected cabbage were collected from the different fields

Preparation of extracts

The stem, leaf and roots of cabbage was cut into small pieces, dried and powdered. The resultant was then subjected for successive extraction with petroleum ether, benzene, chloroform, ethanol and water with soxhlet apparatus. The extracts were then concentrated in vacuum under reduced pressure using rotary flash evaporator and dried in desiccators. These extracts were then subjected to preliminary phytochemical screening for the detection of various plant constituents. Each of these extracts was processed further to evaluate the presence of carbohydrates, proteins, starch and chlorophyll following the established protocols. The powder was treated with acids like 1N HCl, H_2SO_4, HNO_3, Acetic acid and alkaline solutions like 1N NaOH and ammonia. Root, stem and leaf parts of cauliflower were evaluated quantitatively to estimate the total levels of soluble sugars, starch, proteins, lipids and phenols following the established methods for the sugars, starch, lipid, protein19 and phenol 20. All experiments were repeated five times for precision and values were expressed in mean ± standard deviation in terms of air dried material.

RESULTS AND DISCUSSION

Primary metabolites proteins, lipid, soluble sugar, starch and total phenol contents are quantified in different plant parts (root, stem and leaves) and shown in (Table 1). Fresh vegetable part contained total sugar (4.00±0.65gm/gdw) in leaves, starch (6.00±0.56gm/gdw) in leaves, proteins (70.52±0.25µg/mg) in stem, carotenoid (3.51±0.18gm/gdw) in leaves, chlorophyll a (6.03±0.31gm/gdw) and chlorophyll b (6.11±0.53gm/gdw) in leaves. Leaves show maximum concentration of metabolites as compared to its roots and stem. Pest infected vegetable parts contained total sugar (4.98±0.46gm/gdw) in leaves starch (5.07±0.43gm/gdw) in leaves, proteins (87.34±0.32µg/mg) in stem, carotenoid (1.71±0.81gm/gdw) in leaves, chlorophyll a (4.14±0.30gm/gdw) and chlorophyll b (5.78±0.34 gm/gdw) in leaves. Leaves show maximum primary metabolites as compared to its roots and stem. Plant synthesizes primary metabolites (lipid, protein, starch, sugars, phenol etc.) for the normal growth and development of itself. These results are suggestive of primary bioactive compound of commercially importance and may result in great interest in plants pharmaceuticals. Therefore, economic use depends partially on the quantitative and qualitative aspects of their organic reserves, specially carbohydrates, proteins, phenols and lipids. These primary metabolites further can be used for biosynthesis of secondary metabolites or bioactive compounds.

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