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RESEARCH ARTICLE

NUTRITIVE ALTERATION OF CAULIFLOWER HEAD INFECTED WITH *ALTERNARIA BRASSICICOLA* FROM MAHARASHTRA STATE, INDIA

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ABSTRACT

Cauliflower (*Brassica oleracea* L.) were cultivated as a vegetable for their inflorescence meristem. In Indian history, it was assumed that this vegetable was cultivated in India from last 170 years. British people bring this crop to India in 1822(Gopalkrishnan, T.R., 2007). It is the biennial plant. Maharashtra stands eighth among the cauliflower growing states in India. *Alternaria brassicicola* causes head rot disease to cauliflower in Preharvest as well as post-harvest condition. This disease is an important fungal disease. Proper management after harvest and during transportation can reduce its chances of spreading. *Alternaria brassicicola* were collected from 10 different places of Maharashtra. Spores of fungi were collected and cultured on PDA and later used for pathogenicity under test condition of the moist chamber. Nutritive analysis of infected head and fresh (Healthy) head were done, and their comparisons show that Total Carbohydrate, Reducing sugars, vitamin-C and fibre content were drastically reduce whereas the free amino acid content and protein content of the diseased head was increased.

INTRODUCTION

Cauliflower (*Brassica oleracea* L.) belongs to family *Brassicaceae*. It is native to Mediterranean region (Gopalkrishnan, 2007). It is the annual plant growing up to 3 feet in height. It is one of the most important vegetables in Maharashtra. This plant is cultivated throughout many districts of Maharashtra state. Meristematic immature flower buds are the main source of vegetable. It is eaten cooked vegetable or raw in the salad. This crop is affected by head rot caused by *A. brassicicola*. The infection is spread from one head to another in field and storage condition. The humid condition is favourable for a pathogen to grow. *Alternaria brassicicola* (Schw.) belongs to *Deuteromycota* is cosmopolitan in distribution. This fungal pathogen is neurotropic, derive food from killing the cells of a host, commonly affecting to all cruciferous plant. (Nowicki, Nowakowska, Niezgoda and Kozik, 2012). *A. brassicicola* and A. brassicae causes severe economic harm (Humpherson jones and Maude, 1982). Cauliflower is consumed as a vegetable and grown in India in different climatic conditions as this crop can stand in temperature as low as -10OC and as high as 40 OC.

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In Maharashtra, this crop is grown in Nasik, Nagpur and Kolhapur district. Production was up to 21.68 metric tonnes/hector and total area under cauliflower cultivation was 11.00 thousand hectors (Vegetable crop wise data year 2012-13 GOI) *Alternaria brassicicola* causes head rot disease in cauliflower, the diseased head looks dirty olive green or blackish and ultimately the selling gets retarded causes severe loss to seller and farmer. Alternaria produces mycotoxin and may lead to physiological disturbances to the human being (Siciliano *et al*. 2015). As this pathogen is facultative parasite causes the loss in the field and out of field condition. The fungi grow on cauliflower and consume his required nutrient from the host and ultimately causes to depletion in the nutritional value of host.

MATERIALS AND METHODS

In head rot disease of cauliflower in early stages few cells of the head seemed green or brown in colour it looks some type of injury to head. Under the suitable condition, the whole head gets captured by the pathogen in three to five days. Dead necrotic areas were clearly seen on the head. Under severe condition full head of cauliflower converted to olive green in colour.

Table 1. Collection site, culture character, morphology and microscopic examination of *A. brassicicola*

Sr. no.	Place of Collection	Geographical Data	Culture appearance on PDA plate		Conidia length X diameter (Mean)	Beak length	Septae
			Colour of colony	Appearance			
1.	Khandesh -Dhule , Dongargaon	21°04'56.8"N 74°50'33.5"E	Grey	Smooth	32.23 X 9.45	Short	1-3
2.	Khandesh -Chalisgaon	20°27'50.5"N 74°59'55.2"E	Greenish	Smooth	34.80 X 9.65	Short	0-2
3.	Ulhasnagar,Thane	19°13'30.3"N 73°09'42.2"E	Olive	Smooth	41.20 X 9.43	Short	1-2
4.	Kolhapur	16°44'00.5"N 74°14'42.1"E	Olivaceous green	Smooth	40.81 X 8.61	Short	2-3
5.	Vidharbha – Tirora	21°24'19.8"N 79°56'00.9"E	Olive	Smooth	38.40 X 9.10	Short	0-3
6.	Vidharbha –Nagpur, itwari	21°09'09.5"N 79°06'43.0"E	Grey	Smooth	33.60 X8.90	Short	0-1
7.	Marathwada,Nanded, Naigaon	18°50'46.6"N 77°31'42.9"E	Olive green	Smooth	40.00 X 9.10	Short	1-2
8.	Marathwada, Parbhani	19°15'10.5"N 76°47'38.4"E	Grey	Smooth	36.20 X 8.60	Short	1-3
9.	Nashik.Ozar	20°06'19.1"N 73°56'29.6"E	grey	Smooth	36.70 X 9.00	Short	2-3
10.	Konkan , Lonere	18°10'18.1"N 73°20'15.5"E	Grey	Smooth	40.20 X 9.10	Short	0-3

Table 2. Comparative nutrient value of (Control) and diseased and there comparison in % alteration of each nutrient

Sr. no.	Nutrients	Content in 100gram fresh material(Control)	Content in 100gram diseased vegetable	% alteration due to disease
1.	Water content	92.0 Grams	90.5 Grams	-1.630
2.	Total carbohydrate	9.2 Grams	3.4 Grams	-63.043
3.	Reducing sugar	4.6 Grams	1.6 Grams	-65.218
4.	Fibre	2.5 Grams	1.2 Grams	-52.00
5.	Protein	1.2 Grams	1.6 Grams	33.333
6.	Amino acids	0.9 Grams	1.2 Grams	33.333
7.	Lipids	0.1 Grams	00 Grams	-100
8.	Vitamin C	63.00mg	9.0 mg	-85.714
9.	Dry Matter	7.6 Grams	8.1 Grams	6.579

Image 1. Cauliflower head infected with *Alternaria brassicicola* causing head rot disease

Collection of samples

To study nutritive alteration study at least two samples were collected from the different localities of Maharashtra, as Maharashtra is divided into five geographical zones they are Vidharbha, North Maharashtra, West Maharashtra, Konkan and Marathwada.

All samples were brought to the laboratory in a closed sterilised container or plastic bags under low temperature. The samples were studied for disease, pathogen and nutritive aspect as early as possible. To check deterioration of material the samples were kept at -4^{O}C in the deep freezer. Culturing of the pathogen for morphology and pathogenicity: Inoculum isolated from the diseased samples were inoculated on PDA plate and kept at 28±1^{O}C. to check bacterial contamination Ampicillin was mixed in media. A pure culture of the pathogen was established and used it for colonial characters like the colour of colony, texture of colony etc. To confirm the pathogenicity of isolated fungi, the pure isolate were again inoculated on diseased free cauliflower head from the field, and kept it under the controlled condition of temperature and humidity, for this purpose moist chamber was used.

Identification of pathogen

Pathogen identification was carried on the basis of disease symptoms, culture characters, morphological characters and microscopic examination.

Nutrient analysis

In this study primary nutrients were analysed using various protocols given by various researchers and authors.

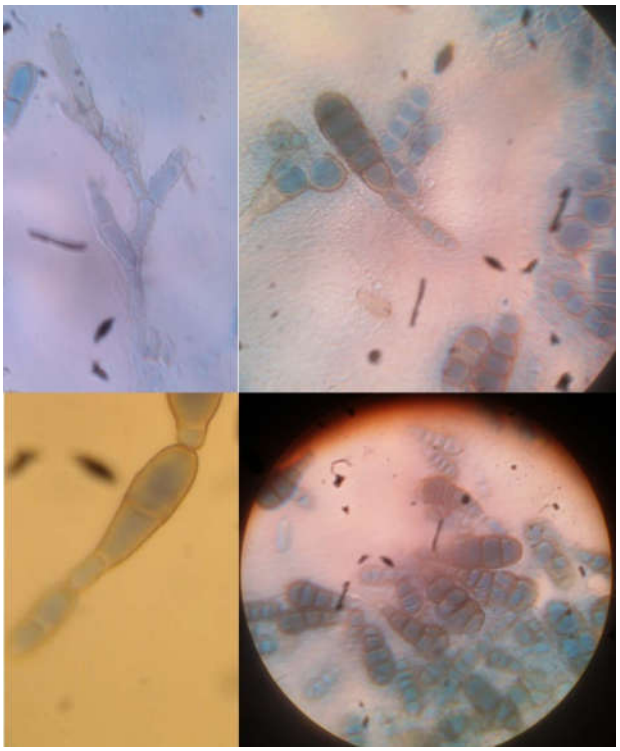
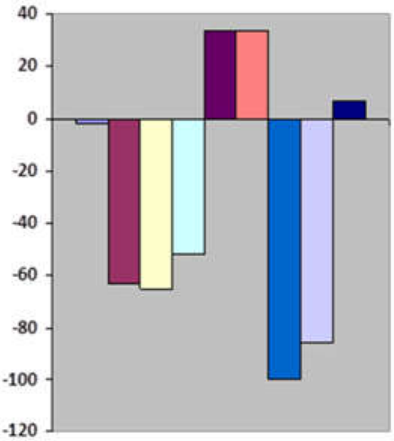


Image 2. Alternaria brassicicola conidiophore, conidia in chain, cluster of conidia



Water content	-1.63
Total carbohydrate	-63.043
Reducing sugar	-65.218
Fibre	-52
Protein	33.333
Amino acids	33.333
Lipids	-100
Vitamin C	-85.714
Dry Matter	6.579

Chart 1. %alteration of nutrient by Alternaria brassicicola causing head rot disease on Cauliflower

Total Carbohydrate was estimated by Hedge, J E and Hofreiter, B T (1962) Antrone method.absorbance of standard glucose and samples of the diseased and healthy head were carried at 630nm using systronics 2202 double beam UV-Visible spectrophotometer. Crude fibre is mainly consist of cellulose and lignin and some minerals. Acid and alkali treatment the cellulose and lignin were degraded. The initial and final weight after ignition at 600 OC give the cruid fibre content in the sample. Reducing sugar were estimated using arsinomolybdate reagent by following the method of Nelson-Somogyi. Absorbance was taken at 520 nm on systronics 2202 double beam UV-Visible spectrophotometer. Lawry method was followed for estimating protein content of diseased and healthy cauliflower head. Absorbance was taken on systronics 2202 double beam UV-Visible spectrophotometer. Oil from cauliflower were extracted through Soxhlet appertatus using Petrolium ether as solvent, following the protocol given by Sadasivam S. and Manickam, (2005). Ninhydrin method was applied for estimation of free amino acids. Absorbance was taken at 570 nm on systronics 2202 double beam UV-Visible spectrophotometer. Dry matter content and water content were analysed by using procedure given by Ruck (1969). Vitamin C content estimated by using 2,6- dichlorophenol-endophenol dye solution, procedure given by Sadasiwam and manickem.

RESULTS

Culture characters, morphology and microscopic properties of isolated pathogen

On PDA media the colony of pathogen shows dark coloured colony from top, and black from backside of plate. The texture of colony was smooth. The hyphae of the fungi initially hyaline which later converted to dark colour. Mycelium septed and branched. Conidiophore arise singly or in bunch form vegetative hyphae. Conidiophore geniculate, dark coloured with swollen base. Conidia arise in chain or single. Basal cell of conidia were swollen and tapered toward apex. Both transverse and longitudinal sepate were observed in conidia, the number of them ranges from 1 to 10 and 0 to 6 in number respectively. Size of conidia range between 18-130µm in length and 8- 30 µm in diameter at the broad portion. Beak was almost 1/6th of total length of conidial length and 6-8 µm in diameter (Ellis, 1971).

Pathogenicity

The isolated fungi when inoculated on fresh cauliflower head and kept in moist chamber, from fourth day the symptoms of head rots were clear the pathogenicity of fungi.

DISCUSSION AND CONCLUSION

Impact of pathogen which grow on vegetable the diseased portion of fully mature head were first infected and later analysed for their nutrient and compared with control, healthy cauliflower head. Comparison between diseased and healthy head clearly indicate the impact of pathogen on biochemical content cauliflower head which make the vegetable less nutritive, as well as less demanded in market.

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