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ANALYSIS OF ORGANIC CONSTITUTENTS IN VARIETIES OF CAPSICUM ANNUUM AND CAPSICUMFRUTSCENS. II- CARBOHYDRATES, CHLOROPHYLL, CAPSICUM AND CAPSAICIN.

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Abstract:-

There are varietal differences in organic acid metabolism, carbohydrate assimilation, and content of nitrogen, protein, polyphenols, chlorophylls, capsicum, capsaicin and ascorbic acid.

Carbohydrate study revealed that starch is the main constituent fraction in chillies varieties under study. It appears that the sugar are mobilized actively for the synthesis of polysaccharides. Total sugars and starch even though synthesizing in lamina, they are not accumulated there but are trans located to fruit, root and stem where they are stored. Capsaicin level vary with the size of fruits, small fruit sized variety contained high capsaicin, and vice versa.

Keywords: Physiological , Capsicum annum and Capsicum frutescens.

INTRODUCTION

Physiological understanding provides a major part of the framework within which the breeder develops his generally implicate thought about what are ideal plants.

Besides the nutritive values, good quality foods are requirements of these days. In crops, like chillie fruit quality must be an important consideration in improvement programme. Breeding for improved quality initially requires a definition of the major parameter that contribute to it. Number of workers such as Shukla et al. (1975), Soochetal. (1977), Bajaj et al. (1977, 1978), Lahadiya and Kulkarni (1978), Bajaj and Kaur (1986), Basiouny and Biswas (1982) , Khadietal. (1987) studied chemical composition of chillie fruit only. But little work has been to illuminate the nutritional requirement of the Capsicum plants (Cotter, 1980). Therefore in present investigation an attempt has been made to understand the growth, yield, organic assimilation mineral nutrient uptake and accumulation in varieties of Capsicum annum viz. Black short, Deonur Byadagi, Jwala, Pant C-1 and Sankeshwari and C. frutescens variety Lavangi. This information is useful for plant physiologists, breeders and food technologists.

The most significant characteristic of green plant is to synthesize food material from the simple substances in the presence of sunlight. It is considered as one of the fundamental and unique properties of the green plants. Plants build-up various kinds of complex molecules. The most important and abundant of these are the carbohydrates, lipids, amino acids, proteins, glycosides, enzymes, vitamins, polyphenols, alkaloids and numerous other organic compounds. Such compounds not only form the cellular organization but also provide energy for all vital activities. Hence it is important to study the various organic constituents present in plants. It has a special significance in economically important plants as their productivity is directly related to the

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metabolism and production of organic compounds.

MATERIALS AND METHODS:

In kharip season ,varieties of Capsicum annum viz. Black short, Deonur Byadagi, Jwala, Pant C-1 and Sankeshwari and C.frutescens variety Lavangi sown in experimental field to study growth, yield, organic and inorganic constituents analysis. Randomized Block Design was set. Three replications of each variety were made consisting of twenty plants. Plant to plant and row to row distance was kept 50 cm and 70 cm respectively.

The organic and inorganic constituents' analysis of different parts has been made after 100-110 days of plants after transplantation. The healthy and well developed plants were uprooted and brought to the laboratory. They were cleaned properly to remove the adherent dirt. The root, stem, leaves and fruits were separated and used for further study.

Quantitative estimation of following organic constituents was made. TAN (Titratable Acid Number), carbohydrates, nitrogen, polyphenols, chlorophyll content, coloring matter (capsicum), capsaicin (pungent principle) and ascorbic acid (vitamin C).The carbohydrates were analyzed calorimetrically by Nelson's method (1944).Chlorophyll content was also determined calorimetrically following Arnon (1949) method. For estimating coloring matter (capsicum), A.O.A.C. (1980) method was adopted. Capsaicin estimated by multiband thin layer chromatography method by Pankar and Magar (1977).For estimation of capsaicin, capsicum and ascorbic acid sundried red fruits were utilized.

RESULTS AND DISCUSSIONS:-

Carbohydrate- Next to protein very important organic constituent is Carbohydrate. In fact photosynthesis exists to synthesize this energy generating molecule. The level of carbohydrates in plants reflect all the general physiology of the growth and development of the plant.

Table -I summaries sugars, starch and total carbohydrate contents in different parts of Capsicum annum varieties Black short, Deonur Byadagi, Jwala, Pant C-1 and Sankeshwari and C.frutescens variety Lavangi. It is clear from the table and Figures that the range of reducing sugar content in root, stem, leaves and fruit in six varieties under investigation is 0.094 to 0.183 g, 0.303 to 0.364g, 0.467 to 0.592 g and 0.148 to 0.196 g per 100 g dry matter respectively. Total sugar content in these varieties varies from 0.206 to 0.332 g in root, 0.303 to 0.460 g in stem, 1.414 to 1.496 g in leaves and 1.118 to 1.612 g per 100 g dry matter in fruits. Starch content varies from 7.50 to 8.74 g in root, 8.01 to 8.64 g in stem, 5.33 to 6.03 g in leaves and 7.72 to 7.99 g per 100 g dye matter in fruits. Total carbohydrate varies from 7.73 to 8.90 g in root of six varieties under study, 8.45 to

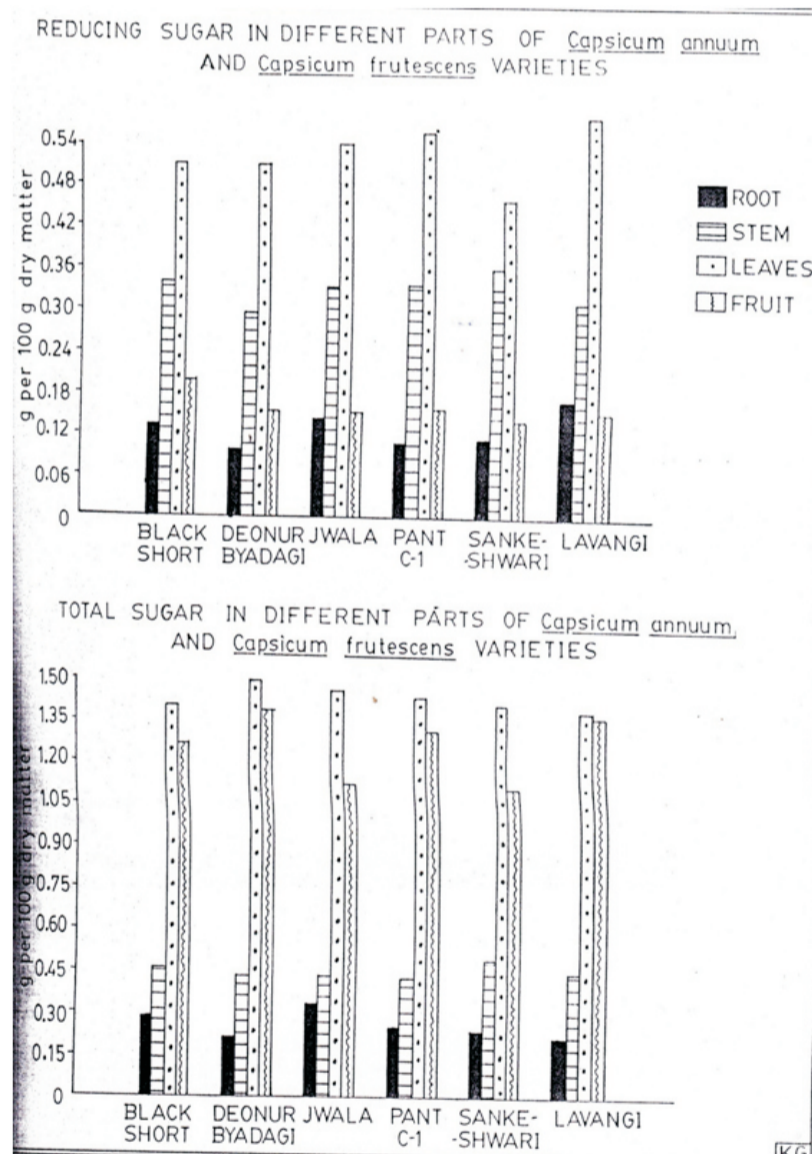
Table -I
Carbohydrates content in different parts of Capsicum annum and C.frutescens.

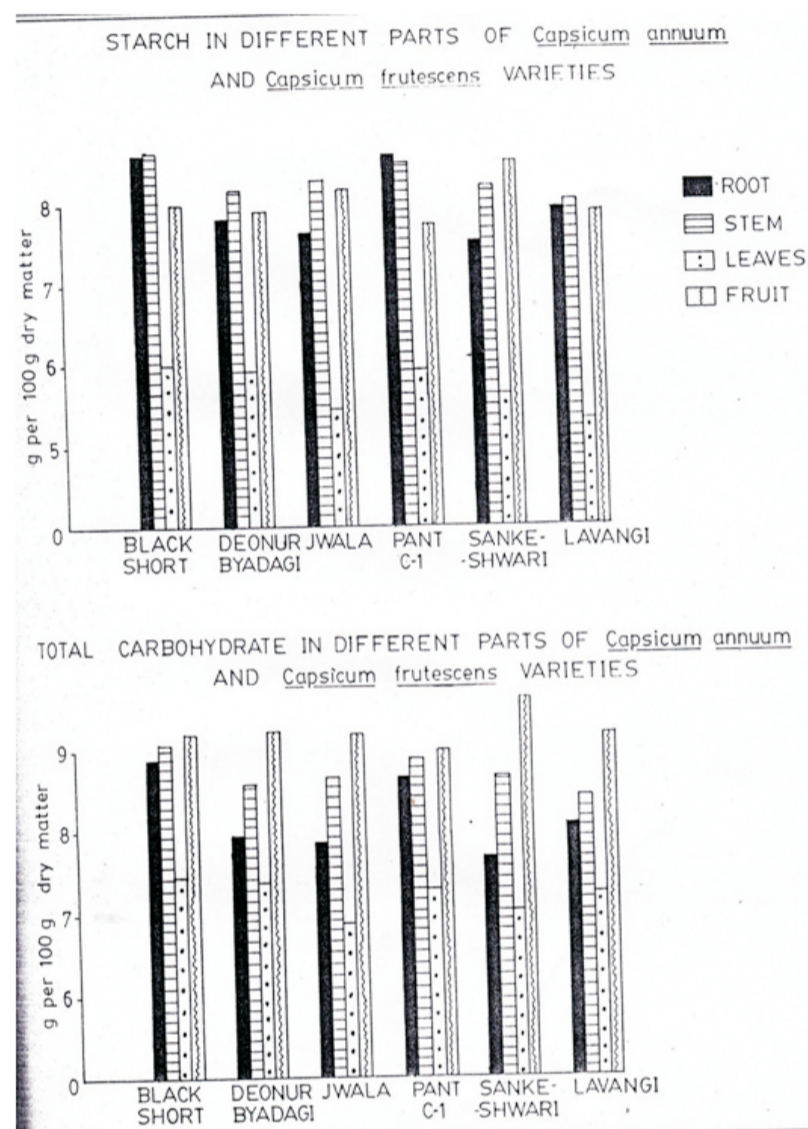
Variety	Carbohydrate	Root	Stem	Leaves	Fruit
Black Short	Reducing sugar	0.140	0.345	0.516	0.196
	Total sugar	0.280	0.460	1.414	1.288
	Starch	8.620	8.640	6.030	7.990
	Total carbohydrates	8.900	9.100	7.440	9.270
Deonur Byadagi	Reducing sugar	0.094	0.303	0.516	0.163
	Total sugar	0.206	0.401	1.496	1.400
	Starch	7.810	8.170	5.380	7.880
	Total carbohydrates	8.016	8.611	7.370	9.280
Jwala	Reducing Sugar	0.153	0.336	0.544	0.156
	Total sugar	0.332	0.432	1.472	1.118
	Starch	7.590	8.310	5.460	8.160
	Total carbohydrates	7.920	8.740	6.930	9.270

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Pant C-1	Reducing sugar	0.114	0.341	0.563	0.163
	Total sugar	0.249	0.439	1.459	1.330
	Starch	8.600	8.500	5.880	7.720
	Total carbohydrates	8.740	8.930	7.330	9.050
Sankeshwari	Reducing sugar	0.118	0.364	0.467	0.148
	Total sugar	0.236	0.504	1.430	1.120
	Starch	7.500	8.190	5.610	8.520
	Total carbohydrates	7.730	8.690	7.040	9.640
Lavangi	Reducing sugar	0.183	0.320	0.592	0.162
	Total sugar	0.210	0.440	1.435	1.400
	Starch	7.900	8.010	5.330	7.840
	Total carbohydrates	8.110	8.450	6.760	9.240

(Value expressed in g per 100 g dry matter.)





9.11 g in stem, 6.76 to 7.44 g in leaves and 7.72 to 8.52 g per 100 g dry matter of fruits of six varieties under study.

It is also evident from the table that the leaves of six varieties under investigation contains more reducing sugars and total sugar than root, stem and fruit. The higher values of reducing sugars and total sugars in leaves may be due to their active synthesis in photosynthesis. The values of reducing sugar are less than total sugars indicate that reducing sugar are not accumulated but are immediately converted into disaccharides and polysaccharides. Further it is also clear that the values of carbohydrates are maximum in the fruit and are followed by stem, root and leaves. Thus fruit represents a major sink for assimilates in capsicum species. Similar observation have also been reported by Hall (1977) in sweet pepper plants. Furthermore, the content of different sugars is critical to the quality of fruit for consumption. It must be mentioned here that pepper fruits are harvested both as unripe and ripe and sugar contents of fruit tissue depends strongly on the harvest time. However,

in the present studies harvest is made when fruits are ripe. The ability of a fruit to impart and utilize assimilates is termed sink strength (Ho, 1988). Sucrose is the major product in the leaves of sweet pepper plants (Nielsen and Veierskov, 1990) and sucrose utilization is expected to be central to sink strength in the fruits (Nielsen et al. (1991).

It is known from the studies of Robinson et al. (1988), Yelle et al. (1988) and Schaffer et al. (1989) in tomato cultivars and Solanum muricatum, respectively, that the carbohydrate composition changes significantly during fruit development. These studies also demonstrated the great potential for the genetic variations of the carbohydrate metabolism in fruits among closely related species. In present investigation also it has been revealed that Capsicum species and varieties under study have a genetic variations of carbohydrate synthesis and accumulation.

Chlorophyll content in leaves of Capsicum annuum variety Black short, DeonurByadagi, Jwala, Pant C-1 and Sankeshwari and in C. frutescens variety Lavangi is presented in Table II It is evident from the table that chlorophyll 'a' and chlorophyll 'b' ranges in between 50.4 to 80.8 mg and 45.12 to 79.49 mg per 100 g fresh tissue respectively in varieties under study. Variety Black short shows higher value of total chlorophylls content (160.2 mg per 100 g fresh tissue). It is followed by Lavangi (116.48 mg %) and subsequently by Sankeshwari (114.52 mg %), Pant C-1.

Table II
Chlorophyll content in leaves of Capsicum annuum and C. frutescens varieties.

Variety	Chlorophyll 'a'	Chlorophyll 'b'	Chlorophyll 'a+b'
Black short	80.8	79.40	160.20
DeonurByadagi	50.4	45.12	95.52
Jwala	55.33	47.18	102.51
Pant C-1	54.71	50.62	105.33
Sankeshwari	59.16	55.36	114.52
Lavangi	59.03	57.45	116.48

Value expressed in mg per 100 g fresh leaves.

Table-III
Capsicum (Coloring matter), Capsaicin content in Fruits of Capsicum annuum and C. frutescens varieties.

Variety	Coloring matter Capsicum ¹	Capsaicin ²
Black short	46.62	0.225
DeonurByadagi	91.08	0.187
Jwala	68.00	0.287
Pant C-1	61.40	0.250
Sankeshwari	59.85	0.175
Lavangi	56.63	0.315

1. Capsicum values expressed as ASTA (American Spice Trade Association) colour units.

2. Capsaicin values expressed as g per 100 g sundried red fruits.

(105.33mg %), Jwala (102.51 mg %) and DeonurByadagi (95.52 mg %)

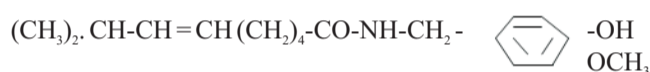
A wide range of variation was observed with respect to chlorophyll content in species/varieties under study. It is evident from the table that the varieties of Capsicum annuum differed widely not only in the levels of chlorophylls but also in the chlorophyll a/b ratio. It is also

interesting to note here that despite the high chlorophyll levels in variety Black short it has low productivity as compared to other varieties of *C. annum* and *C. frutescens*. Although it is unsafe to draw a conclusion in a single case study of this nature, it can be said that chlorophyll levels in *Capsicum* species has little value as marker in assessing germplasm for breeding programme.

Capsicum was estimated in chillie varieties under study and depicted in Table III the table shows that variety DeonurByadagi contains maximum capsicum (91.08 ASTA units) than all other varieties under study. It is followed by Jwala (88.00 ASTA units), Pants C-1 (61.40 ASTA units), Sankeshwari (59.85 ASTA units), Lavangi (56.63 ASTA units) and the lowest capsicum contents in fruits of variety Black short with value of 46.62 ASTA units.

Bajaj et al. (1980) have recorded wide variation in capsicum content in different genotypes of chillies. It varied from 22.30 to 118.63 ASTA units. A wide range in capsicum is also existing in varieties of *Capsicum* under study and high level of capsicum in variety DeonurByadagi is the very reason for its preference by local consumers.

Capsaicin- The most important constituent of red pepper is the pungent principal known as capsaicin, discovered by Thresh (1876). In 1898, Micko showed that the substance had the properties of weak phenol and contained one methoxyl group. He also found that with an alcoholic solution of platinum chloride an odor of vanilla was developed on standing. In 1919, the molecular structure of capsaicin was established by Nelson, who showed it to be the vanillin amide of isodecanoic acid. Molecular formula of capsaicin is $C_{18}H_{27}O_3N$ and the structural formula is



Capsaicin is a digestive stimulant and a cure for many rheumatic troubles (Anonymous, 1984).

The estimated values of capsaicin have shown in Table -III. From this observation table it is seen that variety Lavangi is most pungent (0.315% capsaicin). While, variety Sankeshwari (0.175% capsaicin) is most mild in nature. Variety Black short, Pant C-1 and Jwala showed adequate pungency.

Ramnujam and Tirumalachar (1966) studied 12 chillies varieties and significant variation in respect to capsaicin content. Varietal variation in capsaicin content also observed by Anathaswami et al. (1960), Tirumalachar (1967), Bajaj et al. (1978, 1980). In present investigation, we also found varietal variation in capsaicin content of chillie varieties under study.

Soochet al. (1977) reported a range of 0.25% to 0.49% while Quagliotti (1971) reported a range of 0.472% to 1.208% in oven dried chillie samples. A considerable variation ranging from 0.2% to 1.1% in sundried chillies of new pusa varieties was reported by Tirumalachar (1967). Bajaj et al. (1978) reported a range of capsaicin 0.34% to 0.98% in case of twenty five genotypes. In present investigation the range of variation is 0.175% to 0.315% capsaicin content in *Capsicum* varieties under study. *Capsicum frutescens* variety Lavangi exhibits maximum pungency as compared to *C. annum* varieties under study.

Ananthswami's et al. (1980) reported that capsaicin may also vary with the size of fruits, small sized contained the high concentration of capsaicin and vice versa. Our findings are also in conformity with Ananthswami's report. Varieties Lavangi and Black short having small fruits but contain more capsaicin while Sankeshwari, Deonur Bydadagi have long fruits, with lower amount of capsaicin content.

CONCLUSION-

There are varietal differences in organic acid metabolism, carbohydrate assimilation, and content of nitrogen, protein, polyphenols, chlorophylls, capsicum, capsaicin and ascorbic acid. Carbohydrate study revealed that starch is the main constituent fraction in chillie varieties under study. It appears that the sugar are mobilized actively for the synthesis of polysaccharides. Total sugars and starch even though synthesizing in lamina, they are not accumulated there but are Trans

located to fruit, root and stem where they are stored. Chlorophyll content in *Capsicum annuum* and *C. frutescens* varieties do not show any relation with yield, productivity. Capsaicin level vary with the size of fruits, small fruit sized variety contained high capsaicin, and vice versa.

What emerges from this overall discussion is that plant genotypes of *Capsicum annuum* and *C. frutescens* show important differences in their growth pattern, organic metabolism, uptake, translocation, accumulation and use of essential mineral elements. Advantage should be taken of these differences to improve plants for growth under defined or constrained conditions.

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