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COMPARISON OF FATTY ACID PATTERNS IN PLANT PARTS AND RESPECTIVE CALLUS CULTURES OF *CUCUMIS MELO**

TAPATI HALDER and V. N. GADGIL

Tissue Culture Laboratory, Bose Institute, 93/1, A.P.C. Road, Calcutta, 700009, India

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Key Word Index—*Cucumis melo* var. *utilissimus*; Cucurbitaceae; fatty acids; plant parts; callus cultures; palmitic, linoleic and linolenic acids.

Abstract—Root, hypocotyl, cotyledon, stem and leaf of *Cucumis melo* var. *utilissimus* seedlings were used for callus induction. Comparison was made between these parts, between callus tissues originating from all the parts and between each part and its callus, with respect to the fatty acid composition of total lipids. In all the parts there was a greater proportion of unsaturated fatty acids, the predominant fatty acid in root, stem and leaf being linolenic acid whilst in the cotyledon linoleic predominated. In the hypocotyl these two acids were present in equal amounts. In callus cultures the proportion of saturated acids was greater and the predominant fatty acid was palmitic. The major unsaturated fatty acid in callus cultures was linolenic. The analysis showed that callus tissue and its respective plant part had different fatty acid patterns and that all the callus cultures had very similar patterns irrespective of their origin.

INTRODUCTION

The fatty acid patterns of cotyledons and their callus cultures of six genera and species of Cucurbitaceae was reported earlier [1]. Later, the stage at which callus cultures showed differences in fatty acid composition from that of the cotyledons in *Cucumis melo* var. *utilissimus* was determined [2]. In the present investigation, a comparative study of fatty acid composition of the lipids of the cotyledon, hypocotyl, root, stem and leaf of *C. melo* var. *utilissimus* between callus cultures derived from these plant parts and between the plant part and its respective callus tissue is reported.

*"Fatty Acids in Callus Cultures", Part 4; for Part 3, see ref. [2].

RESULTS

Palmitic ($C_{16:0}$), stearic ($C_{18:0}$), oleic ($C_{18:1}$), linoleic ($C_{18:2}$) and linolenic ($C_{18:3}$) acids were the main fatty acids of the total lipid of the cotyledon, hypocotyl, root, stem and leaf and their callus cultures (Table 1). The proportion

Table 1. Percentage of constituent fatty acids of total lipids from different parts of *Cucumis melo* var. *utilissimus* and the callus cultures derived from these parts*

Fatty acids chain length: number of double bonds	Cotyledon	Cotyledon callus	Hypocotyl	Hypocotyl callus	Root	Root callus	Stem	Stem callus	Leaf	Leaf callus
12:0	—	0.75	—	—	Tr	0.68	—	Tr	0.67	—
13:0	—	—	—	—	—	Tr	—	—	—	—
14:0	—	2.64	Tr	1.22	Tr	2.22	1.33	Tr	0.99	2.45
15:0	—	1.08	—	1.73	—	6.15	0.44	—	0.60	3.27
15:1	—	—	—	—	—	—	—	—	—	—
16:0	17.71	55.37	33.31	53.38	37.16	45.89	43.07	58.11	34.57	46.32
16:1	0.97	—	—	—	—	—	—	—	5.80	—
17:0	—	—	—	0.61	—	—	0.30	—	—	—
17:1	—	—	—	—	—	—	—	—	—	—
18:0	9.40	5.63	3.24	7.75	6.49	4.00	0.20	7.50	4.25	6.54
18:1	20.92	6.70	9.95	3.36	8.05	8.88	9.75	6.70	2.75	5.77
18:2	47.48	5.19	28.19	10.07	8.93	2.26	17.78	5.81	6.83	6.72
18:3	3.52	19.61	25.31	22.06	39.35	29.92	33.54	21.79	43.53	22.80
20:0	—	4.03	Tr	Tr	Tr	Tr	—	Tr	—	3.27
22:0	—	—	—	—	—	—	—	—	—	Tr
Total unsaturated fatty acid	72.89	31.50	63.45	35.49	56.33	41.06	61.07	34.37	58.91	35.29
Total saturated fatty acid	27.11	68.50	36.35	64.51	43.65	58.94	45.36	65.61	41.00	64.71

*Data are expressed in relative percentage w/w; Tr, < 0.1%.

of unsaturated fatty acids in all the parts was greater than the saturated acids. Linolenic acid was the major component of unsaturated fatty acids in the root, stem and leaf while in the cotyledon linoleic was the main constituent. The concentration of oleic acid was high only in the cotyledon. In the hypocotyl, linoleic and linolenic acids were present in more or less equal proportion. Palmitic acid was the major saturated fatty acid in all parts. Short chain fatty acids, namely, lauric ($C_{12:0}$), myristic ($C_{14:0}$) and pentadecanoic ($C_{15:0}$) were detected in small amounts only in stem and leaf. Variation in the proportion of individual components of all the fatty acids was observed in all the parts examined.

All the callus cultures had a higher proportion of saturated fatty acids than any of the plant parts. This was due to an increase in palmitic acid content. The maximum increase of this acid was recorded in the cotyledon callus. Linolenic acid was also the major unsaturated fatty acid in the callus cultures of root, stem and leaf, although its concentration was less than in the respective plant organ. The concentration of linoleic acid, the major unsaturated fatty acid of the cotyledon, was much reduced in the callus culture, and linolenic acid became the major unsaturated fatty acid. In the hypocotyl callus, the concentration of linolenic acid was about twice that of linoleic acid. Small amounts of short chain fatty acids were present in the callus cultures of all the parts except the stem. The long chain fatty acid, arachidic ($C_{20:0}$), was detected only in cotyledon and leaf callus tissues.

DISCUSSION

Extensive data on fatty acid composition are available for seeds and fruits and to a far lesser extent for leaves but data on other plant parts are meagre [3]. In the field of tissue culture, fatty acid composition of different plant parts has been shown to vary widely, e.g. in root, stem, leaf and seed [4, 5]; root, leaf, embryo and endosperm [6]; stem, leaf, embryo and seed [7]; seedling, cotyledon, stem and root [8]. In these studies, callus has been isolated only from root [4–6], cotyledon [4], embryo [7] and seedling [8]. Hence, the difference between the callus derived from one part and that of other parts of the plant is not strictly comparable.

In the present investigation, callus cultures were derived from all the plant parts examined. In fatty acid composition, all the callus cultures differed from those of the respective parts. Such a difference between a particular plant part and its callus is known in other plants [4–9]. The callus cultures of different plant parts had similar fatty acid patterns when isolated and grown under identical conditions. It may be assumed that under the influence of the same growth substances the newly formed meristematic cells of all the cultures assume a similar pattern of fatty acid metabolism.

EXPERIMENTAL

Tissue culture. Suitable segments of cotyledon, hypocotyl, root, stem and leaf of *Cucumis melo* var. *utilissimus* Duthie and Fuller were taken from aseptically grown seedlings. The methods for isolation and growth of callus was reported earlier [1]. Static cultures were continued for six passages (one passage = 45 days) in basal medium [10] containing α-naphthalene acetic acid (1.0 mg/l) and coconut water (15%) and solidified with Difco bacto agar (0.75%). A constant temperature of $25 \pm 1°$ and humidity of 65–70% were used for maintenance of callus tissues, germination and for growing the seedlings from which the calli were derived.

Lipid analysis. All solvents were of analytical grade and redistilled prior to use. All manipulations were carried out in an atmosphere of N_2 as far as feasible. The procedures for extraction and purification of total lipid and GLC analysis of methyl esters of fatty acids were described earlier [1].

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