BIOLOGIA PLANTARUM (PRAHA)

20 (2) : 149—151, 1978

BRIEF COMMUNICATION

Difference between Light- and Wound-induced Biosynthesis of α-Solanine and α-Chaconine in Potato Tubers

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Abstract. Potato tuber tissues can incorporate mevalonic acid-2-^{14}C into glycoalkaloids, namely α-chaconine and α-solanine. The percent incorporation of this labeled precursor into α-chaconine in light exposed tubers is more than that of mechanically injured tubers.

Major glycoalkaloids, namely α-chaconine and α-solanine, which are potent cholinesterase inhibitors occur in potato tubers in various amounts depending upon the variety, stage of development, and environmental conditions. Light and mechanical injury are the two major postharvest environmental factors which stimulate glycoalkaloid formation of potato tubers (Gull and Isenberg 1960, Salunkhe *et al.* 1972, Wu and Salunkhe 1976). Guseva and Paseshnichenko (1958) and Guseva *et al.* (1960) demonstrated the uptake and utilization of labeled acetate for glycoalkaloid synthesis by potato sprouts. They also found that α-chaconine contained nearly twice as much specific activity as α-solanine (Guseva and Paseshnichenko 1962). Jadhav *et al.* 1973 reported the incorporation of labeled carbon from β-hydroxy-β-methylglutaric acid (HMG), L-leucine, L-alanine, and D-glucose into the glycosidic steroidal alkaloids of potato sprouts. Subsequently, glucosylation of solanidine, catalyzed by the crude enzyme preparations from potato sprouts, was demonstrated (Jadhav and Salunkhe 1973). Since light-induced glycoalkaloid formation of potato tubers was shown to be different from that of wound-induced because of their difference in responses to certain inhibitors (Wu and Salunkhe 1977a, b), we decided to investigate the difference between the biosynthesis of α-chaconine and α-solanine in light exposed and mechanically injured tubers.

Russet Burbank and White Rose cultivars were used for the study. DL-mevalonic acid-2-^{14}C (DBED salt, 12.66 mCi mmol^{-1} New England

Received September 12, 1977; accepted September 20, 1977

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Nuclear, Boston, Mass.) was used as labeled precursor. Tubers with uniform size and shape and without any mechanical and pathological injuries were selected. For light treatment, 10 μCi of DL-mevalonic acid-2-^{14}C in 0.25 ml water was evenly applied on 9 cm^2 tuber surface confined by a thin line of vaseline and tubers were exposed to 2150 lx illuminance at 13 °C and 80% R.H. for 1—4 d. For mechanical injury treatment, tubers were cut longitudinally into 2 halves, then treated with a labeled precursor as described above. Cut tubers were incubated in the dark at 13 °C and 80% R.H. for 1—4 d. After incubation, 0.5 cm thick tissue of the treated area of the tubers

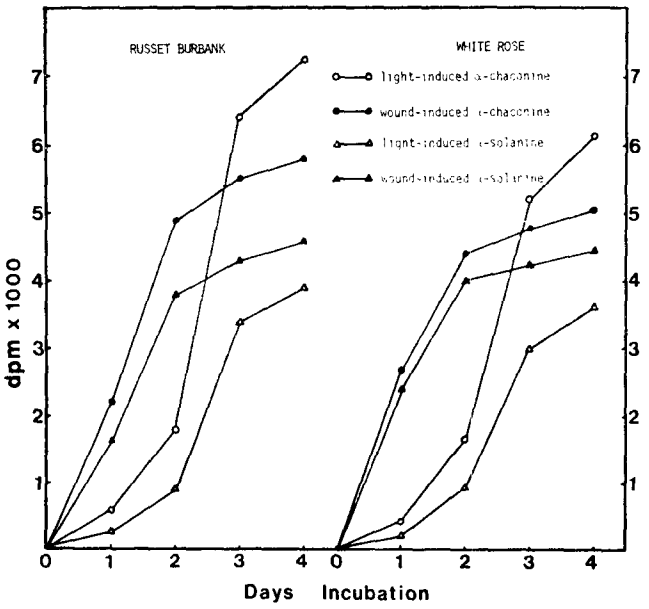

Fig. 1. Incorporation of mevalonic acid-2-^{14}C into α-chaconine and α-solanine of light exposed and mechanically injured potato tubers.

was sliced. The slices were extracted with ethanol, evaporated to dryness, dissolved in 20 ml of 5% sulfuric acid, filtered and precipitated by ammonium hydroxide. The alkaloid fraction was again acidified, reprecipitated, washed with 1% ammonium hydroxide and dissolved to 2 ml with 5% sulfuric acid. α-Chaconine and α-solanine were separated by thin-layer chromatography on Silica gel G (Applied Science Laboratories, State College, Pa) by using 1-butanol : acetic acid : water 10 : 3 : 1 (vol/vol/vol) as developing solvent. Samples of 0.2 ml each were applied as a band on the plates. Standard α-chaconine and α-solanine were also spotted on the plates along with the samples, and the compounds were visualized by spraying with antimony trichloride in acetic acid followed by heating at 70 °C for 20 min. Individual bands were scraped off and collected in a scintillation vial containing 15 ml scintillation liquid (5 g PPO, 0.3 g dimethyl POPOP and 333 ml Triton X-100 in toluene made to 1000 ml), and radioactivity was measured by a scintillation counting system, Packard Model 527 Tri-carb Spectrometer.

1 μCi = 37 kBq.

Potato sprouts, or seedlings, because of their high metabolic activity and ability to synthesize a maximum amount of glycolalkaloid, were exclusively used for biosynthetic precursor incorporation studies in the past. In this study we found that labeled mevalonic acid was also taken up by the tuber tissue for glycoalkaloid synthesis. As shown in Fig. 1, mevalonic acid-2-^{14}C was incorporated into glycoalkaloids of light exposed and mechanically injured potato tubers. Only α-chaconine and α-solanine were found on the TLC plates. The rates of incorporation of labeled precursor varied with cultivars. Under the same condition Russet Burbank cultivar incorporated more precursor than did White Rose cultivar. This is in agreement with our previous findings (WU and SALUNKHE 1976) that White Rose cultivar synthesized less glycoalkaloids than Russet Burbank cultivar under light exposure or with mechanical injury. The percent incorporation of labeled precursor into α-chaconine and α-solanine is different under different treatment conditions. A higher percentage of mevalonic acid-2-^{14}C was incorporated into α-chaconine in light-induced glycoalkaloid (about 65%) than in wound induced glycoalkaloid (about 55%) formation in both cultivars. It is possible that mechanism of light induced glycoalkaloid formation is different at least in certain step(s) from that of wound-induced glycoalkaloid formation in potato tubers.

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