Responses of Lecithin and Hydroxylated Lecithin Coated Potato Tubers to Light

Lecithin and hydroxylated lecithin coating of potato tubers inhibited light-induced syntheses of glycoalkaloids and chlorophylls. Increasing the concentration of lecithin or hydroxylated lecithin in petroleum ether solution increased inhibition. Lecithin was more effective than hydroxylated lecithin in inhibition. Twenty percent of lecithin and hydroxylated lecithin coating of tubers completely inhibited light-induced glycoalkaloid and chlorophyll formation.

A normal whole potato contains very little chlorophylls; however, light will induce synthesis in its peripheral zone. The synthesis is confined mainly to the first 3 mm of tissue, with the highest concentration in the first, where it seldom exceeds 1 mg/100 cm^2 of surface area (Larson, 1949). The formation of chlorophylls is especially vigorous in areas of high metabolic activity such as the apical end, eyes, and meristematic region. The peripheral cells of potato tubers contain large amyloplasts which are formed from proplastids. During the process of greening, these are converted into chloroplasts.

Glycoalkaloids, predominantly α-solanine and α-chaconine, are normally present in potato tubers in small amount, mostly in peripheral zone and eye region. Along with the synthesis of chlorophylls, light also greatly stimulates the synthesis of glycoalkaloids in potato tubers, although the processes of chlorophyll and glycoalkaloid formation are independent of each other (Conner, 1937; Hilton, 1951; Gull and Isenberg, 1958, 1960; Zitnak, 1961). Formation of glycoalkaloids and chlorophyll in light-exposed potato tubers has been shown to be inhibited to certain extent by some physical and chemical agents (Wu and Salunkhe, 1972a,b,c, 1975, 1977; Jadhav and Salunkhe, 1974). This communication presents the responses of light-induced glycoalkaloid and chlorophyll syntheses of potato tubers to coating by hydroxylated lecithin and lecithin.

MATERIALS AND METHODS

Centromix C lecithin, Centrolex F lecithin, and Centrolene A hydroxylated lecithin (Centra Soya Co., Chicago, Ill.) were tested in the study. Three cultivars of potatoes, 'Russet Burbank', 'White Rose', and 'Pontiac', obtained from local potato dealer were used. These tubers have been stored for 8 months. Potato tubers with uniform size and without any mechanical and pathological injuries were selected. Petroleum ether was used to dissolve lecithin and hydroxylated lecithin for coating on potato tubers. Coating was accomplished by dipping individual tubers in the solution and immediately removing for evaporation of the solvent. Potato tubers arranged in a completely randomized block design were then exposed to white fluorescent light (200 ft-c) for 8 days at 13 °C and 80% R.H. After light exposure, peels 2-mm thick of light-exposed parts were removed for chlorophyll and total glycoalkaloid determination. Duplicate analyses were done. Total chlorophylls were determined by the method of AOAC (1965). The Gull and Isenberg method (1960) was used for glycoalkaloid extraction and determination. An automatic shaking device with constant volume pipets was used for color reaction in total glycoalkaloid determination (Wu and Salunkhe, 1976). Analysis of variance was made and means were compared according to Tukey ω-procedure (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

Formation of glycoalkaloids and chlorophylls of potato tubers exposed to light was significantly inhibited by coating of lecithin and hydroxylate lecithin (Table I). However, glycoalkaloids already existed in the tubers were not affected by these treatments. The extent of inhibition depended mostly on the concentration of the lecithin used. Within 5 to 20%, increasing the concentration of lecithin or hydroxylated lecithin resulted in more inhibition of light-induced glycoalkaloid and chlorophyll syntheses of potato tubers. For example, coating with 5% Centrolene A hydroxylated lecithin resulted in 32 to 41% inhibition in glycoalkaloid formation and 36 to 42% inhibition in chlorophyll formation; while 10% coating of the same material resulted in 84 to 86% and 83 to 93% inhibition of glycoalkaloid and chlorophyll formation, respectively. Centromix C lecithin and Centrolex F lecithin had similar effect, however, on the base of the concentration, these two lecithins exerted more inhibition on glycoalkaloid and chlorophyll formation than hydroxylated lecithin. This may be due to the more hydrophilic nature of hydroxylated

Table I. Effects of Lecithin and Hydroxylated Lecithin Coating on Chlorophyll and Glycoalkaloid Formation of Peripheral Zone of Potato Tubers Exposed to 200 ft-c White Fluorescent Light at 13 °C and 80% R.H. for 8 Days[a]

Treatment	Concentration (w/v)	Total glycoalkaloid, mg/100 g of peels			Chlorophyll, mg/100 g of peels		
		Russet Burbank	White Rose	Pontiac	Russet Burbank	White Rose	Pontiac
Initial		19.38	17.95	24.46	0.104	0.175	0.226
Control		48.04	44.59	50.29	4.218	4.639	3.684
Centrolene A	5%	36.49	36.05	40.17	2.745	2.966	2.227
hydroxylated lecithin	10%	24.10	21.58	28.45	0.693	0.549	0.468
	20%	19.20	18.30	24.80	0.096	0.181	0.211
Centromix C lecithin	5%	31.18	30.46	34.86	1.688	1.245	1.044
	10%	21.09	19.42	26.78	0.390	0.410	0.379
	20%	19.44	17.70	24.24	0.115	0.170	0.230
Centrolex F lecithin	5%	29.45	31.08	33.29	1.498	1.384	0.963
	10%	20.87	19.84	26.08	0.414	0.394	0.402
	20%	19.31	18.15	24.65	0.109	0.178	0.219

[a] All the values of treatments in this table are significantly different from respective controls.

lecithin. All these compounds at 20% concentration completely inhibited glycoalkaloid and chlorophyll formation of three cultivars of potato tubers. Our previous report (Wu and Salunkhe, 1977) showed that application of spray lecithin, a mixture of triglycerides, and lecithins resulted in 93–98% inhibition in light-induced chlorophyll formation and 89 to 98% inhibition in glycoalkaloid formation of potato tubers. This study indicated that lecithins alone or hydroxylated lecithin had similar effect on potato tubers as those of mineral oil, triglycerides (Wu and Salunkhe, 1972a,b,c) and mixture of triglycerides and lecithins (Wu and Salunkhe, 1977). The reason for inhibition of chlorophyll and glycoalkaloid formation by lecithin, hydroxylated lecithin, and other hydrophobic compounds is not clear and possibly due to the creation of anaerobic conditions which deprive oxygen necessary for formation of light-induced glycoalkaloids and chlorophyll (Wu and Salunkhe, 1975).

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