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VITAMIN CHANGES INDUCED BY X-RAY IN IRANIAN POTATOES

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ABSTRACT

The results of researches in the field of the using X-ray in all over the world have been successful. The main subject which needs more investigation and have been allocated part of the researches in most of the Atomic Research Institues, is the research about possible harms of irradiated food for human beings, base on this researches, using irradiation for inhibiting of sprouting and preservation of potato is recommended by the group members of scientist (IAEA) in 1976, for developing countries which have faced food deficiency. (1)

Regarding to ever-increasing of population in Iran, to prevent the food wastage a comprehensive study about production, harvesting and preservation of potato was carried out in 1976. (2) Following to that an irradiation experiment of potato for inhibiting of sprouting was carried out in Iran. (3) Then the vitamin changes in potato induced by X-ray was studied.

In this experiment 60 gamma radiation doses of 10, 12 and 15 krad for two varieties of potatoes were tried. The tubers were monthly determined for the following: Ascorbic acid, Thiamin and Riboflavin.

The result of this experiment are as follow: Different doses of gamma ray and preservation times are effective on the amount of potatoes vitamin C, and this effect in both cases would be a losses about 27 to 50%; Also they are effective on the thiamin and reboflavin content of potato. This effect causes a losses less in-comparison with vitamin C.

INTRODUCTION

The nutritive value of radiation-sterilized product is comparable to that of heat-sterilized products. Extensive studies on wholesomeness carried out in recent years have not revealed the presence of injurious compounds. Extensive experimentation indicates that vitamins E and K are particularly sensitive and wholy or partially sensitive and wholy or partially destroyed at the radiation doses required for sterilization. So the radiation has not so much effect on the other vitamins. Thus the investigation about any changes in vitamins of irradiated potatoes with doses 5-20 krad for inhibiting of sprouting has been very limited. (4)

Irradiation 8000-15000 Rep were reported by Canadians has not so much effect on the potatoes vitamin C, and any deficiency is relating to preservation period. (5) The laboratories reports of U.S. army have come to the same results of Canadians researches. (6) The study of biochemical changes induced by gamma radiation have been done by Austerians, they reported that storage time had a greater influence on the vitamin C. content than did radiation dose or storage temperature. If there is any deficiency from radiation treatment, comparing to storage temperature, it is very little. (7)

Study carried out on three varieties of potatoes Baraka, Pashandy and Alfa in 1977 in Iran. Radiation dose was 10, 12, 15 krad and had been preserved for 3, 6, 9 months, vitamin C tests shows significant difference from point of vitamin C comparing to sample control. (3)

No thiamin changing in the irradiated potatoes was reported by P. Wills. It was shown that the thiamin content of potatoes was not reduced when a dose of 16 krad was used followed by 6 months storage at 20^{o}C. (7)

In the last joint committee at FAO/IAEA/WHO, the studies of research centers of different countries were resulted as follow; the effect of dose 10 krad on the potatoes for inhibiting of sprouting, decreases the vitamin C at the most 15 percent. And the amount of thiamin and riboflavin in the irradiated potatoes, comparing to control sample remained unchanged. Nevertheless continuation of more research in this field is suggested by the committee. (1)

The idea of this experiment is to study the changes of vitamins C, B_1, B_2 in two varieties of irradiated potatoes, pashandy and Baraka, with the gamma irradiation of doses 10, 12, 15 krad.

METHODS

Two summer product varieties from north west of Iran with

79± 1 percent moisture were chosen. About 2.5 to 3 months after harvesting, doses of 10,12 and 15 were used. A 300 Ci ^{60} Co irradiation source was used at dose rate of 10-12 krad/h and 20° C temperature. The unirradiated potato from each variety were determined as control. Each treatment had 4 replications, each replication consisted of 2 kilograms of potatoes. The tuber were stored for 3 months in an isothermal room, where the temperature was kept at 8° C with a relative humidity of 75-85%. Throughout the storage period., the samples were monthly determined for the following; vitamin C, Thiamin and Riboflavin.

Moisture content of the samples were estimated before analysis to allow results to be expressed on a moisture-free bases. The amount of vitamin C were measured by using the chemical method (2-4, Dichlorophenol indophenol). (8) Determination of thiamin and riboflavin were done Flourometrically according to the method of the Roche. (9).

Results and Discussion

The amount of moisture, thiamin, riboflavin and ascorbic acid in 100 gram of edible portion of two varieties of potatoes are given in table 1. for comparison, the results are calculated on the dry weight base which is shown in table II.

Vitamin C in potato includes both ascorbic acid and its oxidation product dehydroascorbic acid. Scheunert et al. gave value of 23 to 32 mg. per 100 g. for summer crop potatoes and 13.1 to 25.2 mg. per 100 g. for autums crop potatoes. (10) The amount of vitamin C in the experiment. Pashandy variety which is an autumn product is about minimum (10 mg%). Paterson and Smith reported that the amount of vitamin C in fresh potatoes is more than old ones. (10). In this experiment, the potatoes were used after 2.5 to 3 months of harvesting, therefore the vitamin C deficiency (10 mg%) is acceptable. In spite of different reports relating to unchanging or little changing of ascorbic acid, the effect of different doses of radiation in each month, using the method F trial or variance-analysis, proved a deficiency about 27 to 56%. The same deficiency is reported by Maxie et al, in an experiment in 1964. (11) The F for the effect of preservarion time on the ascorbic acid in the irradiated potatoes shows that preservation time is effective on the amount of ascorbic acid, and this is agreed by most of researcher. (7,12).

The concentration of thiamin in the potatoes tuber reported by Goldenberg varied from 0.24 to 0.80 mg. per 100 g. the majority of

values reported are of the order of 0.07 to 0.1 mg. per 100 g. (10) Variance analysis for the effect of the different dose of irradiation on the preserved potatoes shows that it is effective on the amount of potatoes, thiamin and the maximum decrease is 38% according to tabl III. While Wills reported that the amount of thiamin with irradiation dos 16 Krad is remaining unchanged. (7) On the other hand Kennedy reported that a 24% loss of thiamin occured at 0.5 Mrad and this was increased to 61% at higher doses. (13) Also the preservation time effects on the amount of thiamin which is reported by Meikle John.(10)

Different doses of irradiation was effective on the potatoes riboflavin preserved for 1,2,3 months, losses equal to 42% and 50% with dose 15 Krad was considered. (table IV). Though Kennedy reported in 1965 that irradiatian is not effective on riboflavin. (13) On the othe hand Swallow in 1955 and Gregolin in 1960 in numeraus experiment considered the effect of irradiation as a riboflavin losses. (14) In the same way variance analysis from 3 different preservation times showed that it is effective on the amount of riboflavin.

The result of this experiment are as follow:

1. Different doses of gamma ray and preservation times are effective on the amount of potatoes vitamin C, and this effect in both cases would be a losses about 27 to 50%.
2. Different doses of gamma ray and preservation times are effective on the thiamin and reboflavin content of potato. This effect causes a losses less in comparison with vitamin C.

Since nutritional adequacy and wholesomeness of irradiated foods are prime concerns in ascertaining feasibility of irradiation technology, changes in vitamins in treated foods have received much attention. Unfortunately, many studies involved doses which were unrealistic with regard to product tolerance to irradiation. Results of much studies are of academic interest but should not be used to argue against the application of the process.

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Table I

Vitamin content in irradiated Iranian Potato

	Time (Month)	Pashandy				Baraka			
		Control	10*	12	15	Control	10	12	15
Moisture (g.%)	1	80.15	79.13	79·67	78.57	81.50	77.06	78.25	77.26
	2	78.07	78.12	78.55	77.50	77.65	76.63	76.25	76.07
	3	76.75	77.37	77.45	76.06	77.06	76.83	76.04	76.01
Thiamin (mg.%)	1	0.160	0.126	0.114	0.110	0.150	0.133	0.128	0.118
	2	0.132	0.119	0.108	0.097	0.118	0.107	0.103	0.100
	3	0.097	0.090	0.073	0.061	0.103	0.097	0.095	0.085
Riboflavin (mg.%)	1	0.076	0.073	0.066	0.049	0.075	0.068	0.055	0.046
	2	0.065	0.052	0.053	0.035	0.040	0.038	0.033	0.032
	3	0.043	0.045	0.040	0.028	0.040	0.033	0.029	0.027
Ascorbic (mg.%)	1	9.96	7.25	7.12	6.93	9.67	5.18	5.63	5.32
	2	9.06	6.60	5.98	6.13	8.35	5.65	5.22	5.02
	3	8.26	5.82	5.38	5.15	7.55	5.25	4.70	4.32

* Krad

Table II

Vitamin content in Irradiated Potato*

Vitamins (mg.%)	Time (Month)	Pashandy				Baraka			
		Control	10**	12	15	Control	10	12	15
Thiamin	1	0.81	0.50	0.56	0.51	0.81	0.58	0.58	0.51
	2	0.50	0.46	0.50	0.43	0.52	0.45	0.43	0.42
	3	0.42	0.40	0.32	0.26	0.44	0.41	0.39	0.35
Riboflavin	1	0.38	0.35	0.32	0.22	0.40	0.30	0.25	0.20
	2	0.29	0.23	0.24	0.15	0.18	0.16	0.14	0.13
	3	0.18	0.19	0.17	0.11	0.18	0.14	0.12	0.11
Ascorbic Acid	1	50	34	35	32	52	25	26	23
	2	41	30	27	27	37	24	22	21
	3	35	25	23	21	32	23	20	18

* On dry wieght base

** Krad

Table III

Vitamin losses in irradiated Iranian Potato
Effect of different doses

Vitamin	Time	Pashandy				Baraka			
(mg.%)	(Month)	Control	10*	12	15	Control	10	12	15
		Content	Loss	Loss	Loss	Content	Loss	Loss	Loss
		%	%	%	%	%	%	%	%
	1	0.81	38	30	37	0.81	28	28	37
Thiamin	2	0.50	8	1	14	0.52	12	17	19
	3	0.42	5	24	38	0.44	7	11	20
	1	0.38	8	16	42	0.40	25	38	50
Riboflavin	2	0.29	21	17	48	0.18	11	22	28
	3	0.18	5	5	39	0.18	22	33	39
Ascorbic	1	50	32	30	36	52	52	50	56
Acid	2	41	27	34	34	37	35	41	38
	3	35	29	34	40	32	28	38	44

Table IV
Vitamin losses in Irradiated Iranian Potato
Effect of Preservation times

Vitamin (mg.%)		Pashandy						Baraka					
		1 *		2		3		1		2		3	
		Cont.	loss	Cont.	Loss	Cont.	Loss	Cont.	Loss	Cont.	Loss	Cont.	Loss
		mg.%	%	mg.%	%	mg.%	%	mg.%	%	mg.%	%	mg%	%
		0.81		0.50		0.42		0.81		0.52		0.44	
Thiamin	10**		38		8		5		27		13		7
	12		31		0		24		28		17		11
	15		37		14		38		37		19		20
		0.38		0.29		0.18		0.40		0.18		0.18	
Riboflavin	10		8		21		5		25		11		22
	12		15		17		6		38		22		32
	15		42		48		39		50		28		39
		50		41		53		52		37		32	
Ascorbic	10		32		27		29		52		35		28
Acid	12		30		34		34		50		41		38
	15		36		34		40		56		43		44

* Month

** Krad

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