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BIOCHEMICAL CHANGES ASSOCIATED WITH STORAGE OF SUMMER GROUNDNUT (*Arachis hypogaea* L.) SEEDS

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Abstract- The seeds of RHRG-6021, RHRG- 6083, TAG-24 and JL-501varieties of groundnut were stored and evaluated for oil content (%), protein content, Iodine value of oil, free fatty acid of oil, total polyphenol, saponification value and total soluble sugar. The genotype RHRG-6021 recorded highest oil content (51.65 %). The storage container showed non-significant result for oil content, iodine value, free fatty acid content, protein content and total polyphenol content of groundnut. The highest iodine value was at 270 days of storage in all genotypes of groundnut. The significant differences was observed in free fatty acid content in all four genotypes of groundnut, and among four, JL-501 genotype recorded highest free fatty acid content at 270 days of storage. The higher protein content was recorded in genotype TAG-24 (24.85 %) at start of storage. The groundnut genotype RHRG-6083 exhibited highest polyphenol content at 270 days of storage (0.544) which has increased subsequently during storage. The highest saponification value was observed in JL- 501 (198.2) at 270 days of storage. The saponification value in polylined HDPE bag showed higher value than that in HDPE bag. RHRG-6021 genotype has highest total sugar (7.36) at initial stage, which decreases subsequently. The genotypes stored in polylined HDPE bag had higher total sugar content than HDPE bag.

Keywords- Protein, Free fatty acids, Total Polyphenol, Iodine value, Groundnut, Storage containers

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Introduction

The Groundnut (*Arachis hypogaea* L.) is popular as the king of vegetable oilseeds crops or poor man's nut. Groundnut is a rich source of energy rich oil, which supplies about 500 calories per 100 g, which is higher than all vegetable proteins. Groundnut is also a rich source of minerals and vitamins like vitamin-B, tocopherol (vitamin-E), etc. Groundnut plays an important role in the rural economy of India, which constitute the important component of Indian diet. Kernel contains 48-50 per cent of edible oil, 25 per cent protein and 20 per cent of the carbohydrates. It is also rich in phosphorus and good source of vitamin and minerals.

The quality seed is the cheapest input in modern agriculture. The availability of the viable and vigorous seed at planting time is very important for achieving the target of agricultural production because of this; it acts as a catalyst for realizing the potential of other input. The seed has highest level of viability at maturity, which changes during storage because of deterioration of seed such as delay in germination, reduced seedling growth and decreased tolerance to the adverse germination conditions. The potential storage life of seed varies from species to species and among the varieties. Thus there is need to understand genotypic variability in terms of viability of seed during storage. In view of the above circumstances, present investigation has undertaken with the objective of to study the seed quality of summer groundnut during storage.

Materials and Methods

The present investigation entitled, "Biochemical changes associated with storage of summer groundnut (*Arachis hypogaea* L.) seeds" was carried out during 2011-12 at Seed Technology Research Unit, Department of Agril. Botany and Department of Biochemistry, M.P.K.V., Rahuri on four promising varieties of groundnut *viz.,* RHRG-6021, RHRG- 6083, TAG-24 and JL-501 collected from All India Coordinated Research Project on Groundnut, M.P.K.V., Rahuri. The data on laboratory determination was analyzed by using FCRD method as described by Sendecor and Cochran [1]. Wherever results were significant, the critical differences (C.D.) at 5 per cent level of significance were calculated and used for comparing the treatments. The seed was storage in HDPE bag and Polylined HDPE bag. The following observations were recorded at harvest and monthly interval with appropriate methods. Biochemical analysis of oil content (%) and crude protein contain was determined by using NIR spectrometer, Iodine value of oil, free fatty acid of oil, total polyphenol and saponification value was estimated as per the standard methods of biochemical analysis given by Thimmaiah [2], total soluble sugar was estimated as per the procedure given in standard methods of biochemical analysis by phenol-sulphuric acid method [2].

Results and Discussion

Oil Content (%)

The analyses of variance for oil content influenced by groundnut genotype and storage containers are in [Table-1]. The genotypic differences were statistically significant for oil content at various stages of storage periods. The genotype RHRG-6021 recorded significantly higher mean oil content at o (51.65 %), 90 (50.89%), 180 (49.38%) and at 270 DAH (44.91%). The storage containers showed non-significant effect on oil content (%) of groundnut [Table -2]. The interaction of genotype x storage containers showed non-significant effect on oil content of groundnut. However, RHRG-6021 maintained higher amount of oil content under both the storage containers at various stages of storage periods. The oil content was reduced with advancing age of the storage irrespective to genotypes and storage containers. These results are in conformity with Wilson and Donald [3] as they concluded that oilseeds are very sensitive to the environmental condition and the oil content readily oxidized which deteriorated seed during storage.

The oil content maintained up to 90 days of storage; however, it was declined with the advancement of storage. Among all four varieties, initial mean oil content is ranged between 48.73 % (RHRG-6083) and 51.65% (RHRG-60210). These variations of oil contents were conformity with conclusions of Verma, et al. [4] wherein he reported that the variation in oil content of castor seed was mainly due to differences in genetic makeup of varieties. The oil quantity in groundnut kernels was may be influenced by several parameters such as genetic background, location and seed size these findings similar with Pattee, et al. [5].

Table 1- Main effect of genotypes and storage containers

Treatments	Storage period (DAH)				Storage period (DAH)				Storage period (DAH)			
	0	90	180	270	0	90	180	270	0	90	180	270
Genotypes		on oil content (%)				on iodine value				on free fatty acids		
RHRG-6021	51.65	50.89	49.38	44.91	96.33	98.71	99	101	0.152	0.206	0.421	0.469
RHRG-6083	48.73	47.79	45.76	42.32	93.33	96.4	98.83	101.16	0.269	0.334	0.519	0.62
TAG-24	49.58	48.84	47.37	43.08	94.5	97.7	98.83	101.5	0.289	0.379	0.523	0.656
JL-501	50.63	50.76	48.07	44.2	93.66	98.18	99.16	101	0.292	0.403	0.579	0.675
S.E. +	0.11	0.18	0.22	0.53	0.71	0.65	0.44	0.38	0.005	0.008	0.001	0.004
CD at 5 %	0.34	0.56	0.68	1.61	2.13	N.S.	N.S.	N.S.	0.01	0.02	0.003	0.014
Containers												
HDPE	50.18	49.56	47.54	43.38	94.25	97.75	98.91	101.4	0.251	0.326	0.502	0.615
Polylined HDPE	50.12	49.58	47.75	43.88	94.66	97.76	99	100.9	0.25	0.335	0.519	0.595
S.E. +	0.08	0.13	0.16	0.38	0.54	0.46	0.31	0.27	0.004	0.005	0.008	0.003
CD at 5 %	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.01

Table 2- Interaction effect of genotypes x storage container

Interactions	Storage period (DAH)				Storage period (DAH)				Storage period (DAH)			
	0	90	180	270	0	90	180	270	0	90	180	270
	on oil content (%)				on iodine value				on free fatty acids			
RHRG-6021 x HDPE	51.67	50.87	49.01	45.43	96.66	98.83	99	101.3	0.151	0.202	0.396	0.452
RHRG-6021 x PL-HDPE	51.64	50.91	49.75	44.4	96	98.6	99	100.6	0.151	0.211	0.446	0.487
RHRG-6083 x HDPE	48.71	47.71	45.8	41.7	93	96.23	98.66	101	0.274	0.32	0.518	0.617
RHRG-6083 x PL-HDPE	48.75	47.87	45.73	42.94	93.66	96.23	99	101.3	0.265	0.347	0.52	0.622
TAG-24 x HDPE	49.65	48.84	47.26	42.86	94	98.23	99	102.3	0.293	0.381	0.523	0.694
TAG-24 x PL-HDPE	49.51	48.83	47.47	43.3	95	97.23	98.66	100.6	0.285	0.377	0.523	0.618
JL-501 x HDPE	50.67	50.83	48.1	43.53	93.33	97.36	99	101	0.286	0.402	0.572	0.696
JL-501 x PL-HDPE	50.59	50.7	48.05	44.87	94	99	99.33	101	0.298	0.404	0.587	0.654
S.E. +	0.16	0.26	0.32	0.76	1.008	0.92	0.62	0.54	0.008	0.01	0.001	0.007
CD at 5 %	N.S.	N.S.	N.S.	N.S	N.S.	N.S.	N.S.	N.S	N.S.	N.S.	N.S.	0.02

Iodine Value

It is observed that, there was no any relevance in iodine value in respect to genotypes and storage conditions. However, the iodine value was increased with the advancing age of storage period. The iodine value reached above 100 at 270 DAH. The iodine value exhibited non-significant differences except at 0 day of storage [Table-1]. The storage containers and interaction of genotype x storage showed non-significant result on iodine value of groundnut [Table-2]. The iodine value was higher in groundnut seeds this is also reported by Pattee, et al. [5].

In the present investigation, iodine value increased progressively with the advancement in storage period irrespective to genotype, storage container and its interaction. The genotype RHRG-6021 showed highest iodine value at various storage periods.

Free Fatty Acids

The free fatty acids increased progressively with advancing the storage period irrespective of genotypes and storage containers. The genotypic differences in respect of free fatty acid were found statistically significant during storage period [Table-1]. The lowest free fatty acid was recorded in genotype RHRG-6021 at 0 (0.152), 90 (0.206), 180 (0.421), and at 270 DAH (0.469). In contrast the highest mean free fatty acid was recorded in the genotype JL-501 (0.675) at 270, 180(0.579), 90 (0.403) and 0 (0.292) days of storage. The storage containers showed non-significant differences except at 270 days of storage. The highest value of free fatty acid observed in HDPE bag (0.615) at 270 days of storage. The interaction of genotype x containers show non-significant results [Table-2]. However, the genotypes except RHRG-6021, recorded the highest values for free fatty acids under both the storage containers.

A small quantity of free fatty acids is usually present in oils along with the triglycerides, these increases during storage. The keeping quality of oil therefore relies upon the free fatty acid content [2]. As per Holly and Hammnous [6], high concentration of unsaturated fatty acids in oil has high iodine value and low stability, which is seen in present experiment. The highest free fatty acids were recorded in genotype JL-501, followed by TAG-24. Increase in free fatty acids during storage increases the chances of deterioration of seed viability, because it increases with natural ageing of seeds.

Protein Content (%)

The significant differences were observed in genotypes at 0 days and 270 days of storage [Table-3]. The highest protein content was observed in TAG-24 (24.85%) at 0 days of storage. In contrast lowest was observed in JL-501 (19.19) at 270 days of storage. The storage containers and interaction effect of storage containers x genotypes showed non-significant differences in protein content [Table-4]. However, all the genotypes maintained higher protein content stored in polylined HDPE container.

In the present study, the protein content was slightly declined with the advancing in storage period, in all the genotypes and storage containers. The results were conformity with the results of Zeleny [7], Gupta and Aneja [8] and Shad, et al. [9]. The genotype TAG-24 showed highest protein content (24.85 %) followed by JL-501 (24.48 %). The result in protein content were consent with the findings of Gupta and Aneja [8] wherein they reported that the significant variation in the protein content of soybean seed with respect to varieties and it was inversely correlated with seed germination.

Table 3- Main effect of genotypes and storage containers

Treatments	Storage period (DAH)				Storage period (DAH)				Storage period (DAH)			
	0	90	180	270	0	90	180	270	0	90	180	270
Genotypes	on protein (%)				on saponification value				on total polyphenols			
RHRG-6021	23.23	20.92	20.65	19.78	155.4	167.16	181.48	191.7	0.482	0.495	0.501	0.518
RHRG-6083	23.68	22.26	20.48	19.45	152.13	159.86	181.31	194.2	0.514	0.514	0.531	0.544
TAG-24	24.85	22.41	21.42	20.28	150.21	163.55	179.96	196.6	0.496	0.505	0.516	0.545
JL-501	24.48	22.22	20.64	19.19	151.6	164.5	183.52	198.2	0.487	0.493	0.503	0.515
S.E. +	0.21	0.39	0.41	0.17	3.19	0.73	1.23	1.16	0.006	0.001	0.004	0.004
CD at 5 %	0.63	N.S.	N.S.	0.51	N.S.	2.19	N.S.	3.49	0.02	0.005	0.01	0.01
Containers												
HDPE	24.12	21.79	20.65	19.62	151.01	163.78	179.61	194.8	0.494	0.502	0.513	0.534
Polylined HDPE	24.03	22.12	20.63	19.72	153.66	163.75	183.53	195.6	0.495	0.501	0.512	0.527
S.E. +	0.14	0.28	0.29	0.12	2.25	0.51	0.87	0.82	0.004	0.001	0.003	0.003
CD at 5 %	N.S.	N.S.	N.S..	N.S	N.S.	N.S.	2.62	N.S.	N.S.	N.S.	N.S.	N.S.

Table 4- Interaction effect of genotypes x storage container

Interactions	Storage period (DAH)				Storage period (DAH)				Storage period (DAH)			
	0	90	180	270	0	90	180	270	0	90	180	270
	on protein (%)				on saponification value				on total polyphenols			
RHRG-6021 x HDPE	23.16	20.46	20.66	19.4	154.03	166.9	179.7	190.13	0.482	0.497	0.502	0.519
RHRG-6021 x PL-HDPE	23.11	21.38	20.65	20.16	156.76	167.4	183.25	193.2	0.482	0.492	0.5	0.516
RHRG-6083 x HDPE	23.71	22.31	20.55	19.56	148.07	159.03	180.9	194.5	0.512	0.519	0.536	0.55
RHRG-6083 x PL-HDPE	23.66	22.21	20.42	19.34	156.2	160.7	181.7	193.8	0.516	0.508	0.527	0.538
TAG-24 x HDPE	24.81	22.21	21.66	20.48	150.46	164.5	126.3	195.2	0.497	0.498	0.511	0.551
TAG-24 x PL-HDPE	24.89	22.61	21.18	20.07	149.96	162.6	183.6	198.13	0.495	0.513	0.521	0.539
JL-501 x HDPE	24.81	22.16	19.75	19.06	151.46	164.7	181.4	199.43	0.484	0.495	0.505	0.516
JL-501 x PL-HDPE	24.15	22.29	20.28	19.31	151.73	164.3	185.5	197.13	0.489	0.492	0.501	0.515
S.E. +	0.29	0.56	0.58	0.24	4.51	1.03	1.75	1.64	0.009	0.002	0.006	0.006
CD at 5 %	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.007	N.S.	N.S.

Saponification Value

The saponification value increased with the advancement of storage period irrespective to genotypes and storage condition. The genotypic differences in respect of saponification value show variable results [Table-3]. The highest saponification value was observed in JL-501 genotype at 270 (198.2), 180 (183.52) and 90 (164.50) days of storage. The storage containers showed significant difference only at 180 days of storage. The polylined HDPE container maintained higher saponification values at various storage periods. The interaction of genotype x storage container showed non-significant difference [Table-4].

The data pertaining saponification value revealed that the values were increased with the increase in storage period in all genotypes and storage containers. The genotype RHRG-6021 has highest saponification value (155.4). Lowest saponification value was observed in the TAG-24 genotype (150.21). The variation in saponification value may be due to genetic variation and or different growing locations, the results are in conformity with Narshimhachar, et al. [10] and Nagaraj [11].

Total Polyphenols

The total polyphenols increased progressively with advancement of storage period irrespective to genotypes and storage containers. The significant differences were observed in genotypes studied for total polyphenols [Table-3]. The highest mean protein was observed in TAG-24 (0.545) at 270 days of storage, whereas, RHRG-6083 had higher polyphenols at 0 (0.514), 90 (0.514), and 180 (0.531) DAH. The main effect of storage container on total polyphenol was non-significant difference during storage period. The interaction effect of genotype x storage container showed non-significant difference except at 90 days of storage [Table-4].

The variations among all four varieties for total polyphenol content

was may be due to variation in genetic makeup, maturity, seed texture and time of harvesting, the same results are reported by Khare, et al. [12].

Total Sugar

The genotypic differences in respect of total sugars were found statistically significant at various storage periods [Table-5]. The highest sugar was found in RHRG-6021 genotype at 0 (7.36), 90 (6.40), 180(5.36) and 270(4.43) days of storage. The storage containers showed variable results for total sugar. The differences were statically significant at various storage periods except 0 DAH. The lowest sugar content was observed in HDPE bag at 270 days of storage (3.74) whereas it was highest at initial condition in same container (6.73). The interaction of storage containers and genotype showed non-significant difference except 180 days of storage [Table-6]. However, the genotypes RHRG-6021 and JL-501 recorded higher total sugars under both the storage containers.

Table 5- Main effect of genotypes and storage containers on total sugar

Treatments	Storage period (DAH)			
	0	90	180	270
Genotypes				
RHRG-6021	7.36	6.4	5.36	4.43
RHRG-6083	6.01	5.2	4.4	3.38
TAG-24	6.56	5.19	4.39	3.42
JL-501	6.85	6.17	5.24	4.22
S.E. +	0.07	0.07	0.06	0.04
CD at 5 %	0.2	0.22	1.18	0.14
Container				
HDPE	6.73	5.6	4.71	3.74
Polylined HDPE	6.66	5.87	4.99	3.9
S.E. +	0.05	0.05	0.04	0.03
CD at 5 %	N.S.	0.15	0.13	0.1

Table 6- Interaction effect of genotypes x storage container on total sugar

Interaction	Storage period (DAH)			
	0	90	180	270
RHRG-6021 x HDPE	7.39	6.15	5.3	4.3
RHRG-6021 x PL-HDPE	7.33	6.65	5.43	4.56
RHRG-6083 x HDPE	6.1	5.05	4.16	3.33
RHRG-6083 x PL-HDPE	5.93	5.35	4.65	3.43
TAG-24 x HDPE	6.53	5.11	4.15	3.16
TAG-24 x PL-HDPE	6.6	5.28	4.63	3.31
JL-501 x HDPE	6.9	6.11	5.23	4.16
JL-501 x PL-HDPE	6.8	6.23	5.25	4.28
S.E. +	0.11	0.1	0.08	0.06
CD at 5 %	N.S.	N.S.	0.26	N.S.

The water-soluble sugars in seed decreases during longer storage, due to leaching as confirmed by Agarwal & Khasiluki, [13]. In the present study, the total sugars were declined with the advancement of storage period in all the genotypes and storage containers. The highest total sugar content was recorded in RHRG-6021 genotype (7.36) followed by JL-501 (6.85). The groundnut genotypes showed relatively higher total sugar content which were stored in polylined HDPE container. Interaction of genotype x storage container showed nonsignificant differences. The results were confirmed with that of Wettaufer & Leopold [14] and Yaklich [15].

Hence we lead to conclude that the storage containers like HDPE and Polylined HDPE do not influence the biochemical parameters to such extent, as showed non-significant result for oil content, iodine value, free fatty acid content, protein content and total polyphenol content of groundnut. In addition, all the parameters studied are shows variation according to cultivar tested; it confirms the distinctness of each cultivar, which will be useful for variety identification and differentiation by using biochemical tests.

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