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Influence of Packaging Materials on Hardness of Cashew Kernel

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Abstract

The cashew kernels were packed in three polyethylene bags having thickness 100 gauge, 200 gauge and 300 gauge. Cashew kernels were packed in total 30 bags for each gauge and stored for 10 weeks. The sealing of bags was done on continuous band sealer. Then samples were analyzed under Texture analyzer and the force required to rupture the cashew kernels was recorded. During study it was observed that due to permeability of packaging material to the moisture, the moisture content of Cashew Kernels get increased which tend to soften the cashew kernels. Thus as storage period increases the hardness of cashew kernels decreases due to moisture. Thus it was found that 300 gauge polyethylene bag is more suitable to store cashew kernels for longer period of time i.e. up to 10 weeks as compared to other polyethylene bags.

Key words: Polyethylene bag, packaging material, Cashew Kernel, texture analyzer, band sealer.

I. INTRODUCTION

The Cashew mainly serves the nutritional and medicinal purposes. The Cashew kernel is a rich source of fat (46 %) and protein (18%) and is also a good source of vitamin calcium, phosphorus and iron (Anonyms, 2007). It has high percentage of polyunsaturated fatty acids, particularly Linoleic acid. In India Cashew processing is followed by collection of raw cashew nuts, steaming or roasting, shelling of nuts, drying of kernels, grading of kernels, packaging and transport or marketing (Rao, 2009)

The packaging is one of the most important unit operations in the processing to increase the shelf life of commodity. The main function of a package is to contain the product and protect it against a variety of hazards which might adversely affect its quality during handling, distribution and storage. Packaging also maintains the quality of product for longer period of time. Packaging makes handling of the product easy and increase the marketability. As the storage life of product increases ultimately increases the profit and makes processing profitable. To find the changes in the cashew during storage, hardness could be major component which is going to be affected.

Considering all these problems in processing, packaging and storage of cashew kernels, this study was undertaken to study the effect of different packaging materials on hardness of cashew kernels.

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II. MATERIALS AND METHODS

Materials:

"*Vengurla 4*" variety of cashew kernels was used for the packaging purpose. The sample was collected from small scale cashew processor. The polyethylene bags of different thickness (100 gauge, 200 gauge and 300 gauge) were used as packaging material. Equipment and machines used include BrookField Texture Analyzer, Continuous Band Sealer, Air Oven and Weighing Balance.

Methods:

Sealing of Cashew Kernels on continuous band sealer

The cashew Kernels with quantity of 60 g were filled in polyethylene bags of 100 gauge, 200 gauge and 300 gauge each.All the filled bags were immediately sealed on continuous band sealer.

Determination of moisture content

After one week of storage three bags of each gauge were taken from storage for analysis. Total nine bags were selected for analysis. The moisture content of Cashew Kernels stored in each bag was determined by Air oven method by keeping samples in sample box for 24 hrs at 105°C.

Textural analysis of Cashew Kernels

Textural analysis of Cashew Kernels was carried out with the help of BrookField Food Texture Analyzer.
The process was started by filling required information of the test sample in the software.

- Information provided:

1. Procedure
   Total cycle= 1
   Trigger point= 10 g
   Test speed= 30 mm/min
   Target value= 3 mm
   Probe type= TA-25

2. Target test
Compression

3. Target unit
   Load
   Distance
   % deformation

4. Texture results

i Primary calculations
   Fracture force 1
   Hardness cycle 1
   Apparent modulus
   Adhesive force
   Deformation
   Adhesiveness

ii secondary calculation
   Quantity fracture
   1st fracture drop off
   1st fracture deformation
   1st fracture % deformation
   1st fracture work done
   Stringiness length
   Hardness work done
   Recoverable deformation
   Recoverable work done

iii Additional calculations
   Rigidity 1
   Rigidity 2
   Temperature
   Sample length

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5. General results

i Standard results
- Peak load
- Deformation at peak load
- Peak stress
- Stress peak 1
- Final load
- Deformation at final load
- Average peak

ii Special results
- Mean load

6. Compression
- Load at rupture
- Stress at rupture
- Deformation at rupture

Procedure for Texture analysis of Cashew Kernels

Hold the sample on platform base
↓
Use probe 'TA-25' for test
↓
Starting the machine
↓
The probe penetrates in sample
↓
The graphical representation is obtained on computer according to penetration of probe from start to end by using 'Texture-pro' software.
↓
Take total nine tests

Treatment details

Treatment	Particulars
T1	Cashew Kernel samples packed in 300 gauge polyethylene bag
T2	Cashew Kernel samples packed in 200 gauge polyethylene bag
T3	Cashew Kernel samples packed in 100 gauge polyethylene bag

III. RESULT AND DISCUSSION

Effect of polyethylene thickness on hardness o f Cashew Kernels

Fig. (1) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 2341 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 2470.67 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 2562.70 g.

Fig. (2) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 1953 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 2344.67 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 2380.70 g. If the comparison of 1st week sample with 2nd week sample is done, it is found that the average load of rupture required for samples stored in 100 gauge polyethylene bag us reduced to 279 g. Similarly, the samples stored in 200 gauge and 300 gauge polyethylene bag shown reduction in load of rupture as 126 g and 182 g respectively. Whereas the increase in the moisture content was by 0.4 percent, 0.4percent and 0.2 percent (w. b.) for samples packed in 100 gauge, 200 gauge and 300 gauge polyethylene bag respectively.

Fig. (3) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 1926 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 1980 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 2074.60 g. The load of rupture for samples stored in100 gauge, 200 gauge and 300 gauge polyethylene bag was reduced to 27 g, 364 g and 306 g respectively against 2 weeks of storage and reduced to 306 g, 490 g and 488 g respectively against 1 week of storage.

Fig. (4) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 1606 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 1950 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 2010.70 g. The reduction in load of rupture for samples packed in 100 gauge, 200 gauge and 300 gauge polyethylene bag was by 320 g, 30 g and 64 g respectively against 3 weeks of storage whereas 347 g, 394 g and 370 g against 2 weeks of storage and 626 g, 520 g and 552 g against 1 week of storage.

Fig. (5) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 1644 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 1830 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 2000 g. The reduction in load of rupture for samples packed in 100 gauge, 200 gauge and 300 gauge polyethylene bag was by 38 g, 120 g and 10 g respectively against 4 weeks of storage, 282 g, 150 g and 74 g against 3 weeks of storage, whereas 309 g, 514 g and 380 g against 2 weeks of storage and 588 g, 640 g and 562 g against 1 week of storage.

Fig. (6) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 1590 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 1700 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 2016 g. The reduction in load of rupture for samples packed in 100 gauge, 200 gauge and 300 gauge polyethylene bag was by 54 g, 130 g and 16 g respectively against 5 weeks of storage, 16 g, 250 g and 6 g against 4 weeks of storage, 336 g, 280 g and 58 g against 3 weeks of storage, whereas 363 g, 644 g and 362 g against 2 weeks of storage and 642 g, 770 g and 546 g against 1 week of storage.

Fig. (7) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 1605 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 1630 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 1852 g. The reduction in load of rupture for samples packed in 100 gauge, 200 gauge and 300

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gauge polyethylene bag was by 15 g, 70 g and 164 g respectively against 6 weeks of storage, 39 g, 200 g and 148 g against 5 weeks of storage, 44 g, 320 g and 158 g against 4 weeks of storage, 321 g, 350 g and 222 g against 3 weeks of storage, whereas 348 g, 714 g and 528 g against 2 weeks of storage and 627 g, 840 g and 710 g against 1 week of storage.

Fig. (8) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 1507 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 1774 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 1780 g. The reduction in load of rupture for samples packed in 100 gauge, 200 gauge and 300 gauge polyethylene bag was by 98 g, 144 g and 72 g respectively against 7 weeks of storage, 83 g,74 g and 236 g against 6 weeks of storage, 137 g, 56 g and 220 g against 5 weeks of storage, 99 g, 176 g and 230 g against 4weeks of storage, 419 g, 206 g and 294 g against 3 weeks of storage, whereas 446 g, 570 g and 600 g against 2 weeks of storage and 725 g, 696 g and 782 g against 1 week of storage.

Fig. (9) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was 1331 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 1364 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 1724 g. The reduction in load of rupture for samples packed in 100 gauge, 200 gauge and 300 gauge polyethylene bag was by 176 g, 410 g and 56 g respectively against 8 weeks of storage, 274 g, 266 g and 128 g against 7 weeks of storage, 259 g, 366 g and 292 g against 6 weeks of storage, 313 g, 466 g and 276 g against 5 weeks of storage, 275 g, 586 g and 286 g against 4 weeks of storage, 595 g, 616 g and 350 g against 3 weeks of storage, whereas 622 g, 980 g and 656 g against 2 week of storage and 901 g, 1106 g and 838 g against 1 week of storage.

Fig. (10) indicates that among the cashew kernels packed in polythene bag with 100 gauge have shown average peak load required to rupture was1209 g, the cashew kernels packed in 200 gauge polythene bag shown the average peak load to rupture was 1225 g and the cashew kernels packed in polythene bag with 300 gauge have shown average peak load required to rupture was 1635 g. The reduction in load of rupture for samples packed in 100 gauge, 200 gauge and 300 gauge polyethylene bag was by 122 g, 139 g and 89 g respectively against 9 weeks of storage, 298 g, 549 g and 45 g against 8 weeks of storage, 396 g, 405 g and 217 g against 7 weeks of storage, 381 g, 475 g and 387 g against 6 weeks of storage, 435 g, 605 g and 365 g against 5 weeks of storage, 397 g, 725 g and 375 g against 4 weeks of storage, whereas 717 g, 755 g and 439 g against 3 week of storage, whereas 744 g, 1119 g and 745 g against 2 weeks of storage and 1023 g, 1245 g and 927 g against 1 week of storage.

Fig. (11) indicates that the reduction in load of rupture of Cashew Kernels stored in 100 gauge polyethylene bag for 2 weeks was 362 g. against 1 week of storage.

The comparison of reduction in load of rupture for 3 weeks samples with 1 and 2 week stored samples was 380 g and 40 g. respectively.

The 4 weeks stored samples show the reduction in load of rupture as compared with 1, 2 and 3 weeks as 712 g, 350 g and 313 g respectively.

The samples stored up to 5 weeks duration show reduction in load up to 731 g, 369 g, 332 g and 19 g as compared to one, two, three and four weeks respectively.

The reduction in load of rupture of samples stored up to 6 weeks was 761 g, 400 g, 362 g, 49 g and 30 g against one, two, three, four and five weeks respectively.

The comparison of reduction in load of rupture for 7 weeks samples with one to six weeks stored samples was 833 g, 471 g, 434 g, 121 g, 102 g and 72 g respectively.

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The 8 weeks stored samples show the reduction in load of rupture as compared with one, two, three, four, five, six and seven weeks as 900 g, 537 g, 500 g, 187 g, 168 g, 138 g and 66 g respectively.

The samples stored up to 9 weeks duration show reduction in load of rupture up to 973 g, 611 g, 574 g as compared to one, two, three weeks and 261 g, 242 g, 212 g, 140 g and 74 g as compared to four, five, six, seven and eight weeks respectively.

The comparison of reduction in load of rupture for 10 weeks stored samples with one, two, three, four, five, six, seven, eight and nine weeks was 1121 g, 769 g, 722 g, 409 g, 310 g, 360 g, 288 g, 212 g and 140 g. respectively.

This indicates that total reduction in load was 1121 g from 1 week to 10 weeks of storage. This indicates that due to moisture migration the load of rupture and hardness of Cashew Kernel was reduced from 2341 g to 1220 g.

Fig. (12) indicates that the reduction in load of rupture of Cashew Kernels stored in 200 gauge polyethylene bag for 2 weeks was 151 g. against 1 week of storage.

The comparison of reduction in load of rupture for 3 weeks samples with 1 and 2 week stored samples was 396 g and 245 g. respectively.

The reduction in load of rupture of samples stored up to 4 weeks was 460 g, 310 g, and 64 g. against one, two, and three weeks respectively.

The samples stored up to 5 weeks duration show reduction in load of rupture up to 550 g, 400 g, 154 g and 90 g. as compared to one, two, three and four weeks respectively.

The 6 weeks stored samples show the reduction in load of rupture as compared with one, two, three, four and five weeks as 710 g, 559 g and 314 g, 250 g and 160 g respectively.

The reduction in load of rupture of samples stored for 7 week was 790 g, 639 g, 394 g, 330 g, 240 g and 80 g as compared to one, two, three, four, five and six weeks respectively.

The 8 weeks stored samples show the reduction in load of rupture as compared with one, two, three, four, five, six and seven weeks as 840 g, 689 g, 444 g, 380 g, 290 g, 130 g and 50 g respectively.

The samples stored up to 9 weeks duration show reduction in load of rupture up to 1028 g, 877 g, 632 g as compared to one, two, three weeks and 508 g, 478 g, 318 g, 238 g and 188 g as compared to four, five, six, seven and eight weeks respectively.

The 10 weeks stored samples show the reduction in load of rupture as compared with one to nine weeks as 1190 g, 1046 g, 801 g, 737 g, 647 g, 487 g, 407 g, 357 g and 169 g respectively.

This indicates that total reduction in load was 1190 g from 1 week to 10 weeks of storage. This indicates that due to moisture migration the load of rupture and hardness of Cashew Kernel was reduced from 2470 g to 1273 g.

Fig. (13) indicates that the reduction in load of rupture of Cashew Kernels stored in 300 gauge polyethylene bag for 2 weeks was 219 g. against 1 week of storage.

The comparison of reduction in load of rupture for 3 week samples with 1 and 2 week stored samples was 488 g and 269 g. respectively.

The 4 week stored samples show the reduction in load of rupture as compared with 1, 2 and 3 weeks as 546 g, 327 g and 58 g respectively.

The samples stored up to 5 weeks duration show reduction in load up to 552 g, 333 g, 44 g and 6 g as compared to one, two, three and fours weeks respectively.

The reduction in load of rupture of samples stored up to 6 weeks was 562 g, 343 g, 74 g, 16 g and 10 g against one, two, three, four and five weeks respectively.

The comparison of reduction in load of rupture for 7 weeks samples with one to six weeks stored samples was 710 g, 491 g, 222 g, 164 g, 158 g and 148 g respectively.

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The 8 week stored samples show the reduction in load of rupture as compared with one, two, three, four, five, six and seven weeks as 798 g, 579 g, 310 g, 252 g, 246 g, 236 g and 88 g respectively.

The samples stored up to 9 weeks duration show reduction in load of rupture up to 822 g, 604 g, 334 g as compared to one, two, three weeks and 276 g, 266 g, 256 g, 112 g and 24 g as compared to four, five, six, seven and eight weeks respectively.

The 10 week stored samples show the reduction in load of rupture as compared with one to nine weeks as 896 g, 677 g, 408 g, 350 g, 344 g, 334 g, 186 g, 98 g and 74 g respectively.

This indicates that total reduction in load was 896 g from 1 week to 10 weeks of storage. The increase in moisture content was from 4.1 percent to 5.8 percent (w. b.). This indicates that due to moisture migration the load of rupture and hardness of Cashew Kernel was reduced from 2262 g to 1666 g.

Effect of polyethylene thickness on moisture content

The results show that the moisture content of all samples increased with decrease in thickness of polyethylene bags.The moisture content measured up to ten weeks storage duration shows that there is increase in moisture content of cashew kernels packed in 100 gauge polyethylene bag than cashew kernels packed in 200 gauge and 300 gauge polyethylene bag. The analysis shows that moisture transmission rate increases with decrease in thickness of polyethylene packaging material.

Table (2) indicates that the moisture content of cashew kernels packed in 100 gauge polyethylene bag is increased from 4.9 percent (w.b.) to 7.6 percent (w.b.). The moisture content of cashew kernels packed in 200 gauge polyethylene bag is increased from 4.4 percent (w.b) to 6.5 percent (w.b.). The moisture content of cashew kernels packed in 300 gauge polyethylene bag is increased from 4.1 percent (w.b.) to 5.8 percent (w.b.).

Figures and Tables

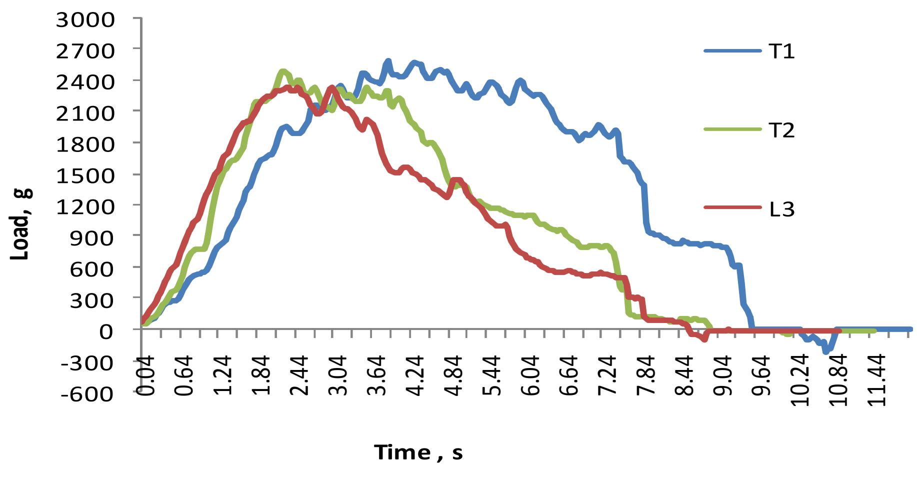

Fig. 1 Load Vs. Time of Cashew Kernels stored for one week in different packaging materials.

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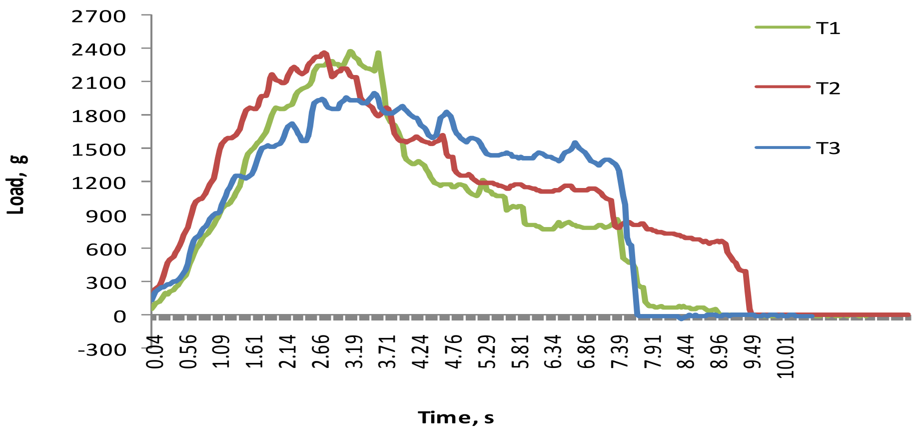

Fig. 2 Load Vs. Time of Cashew Kernels stored for two weeks in different packaging materials.

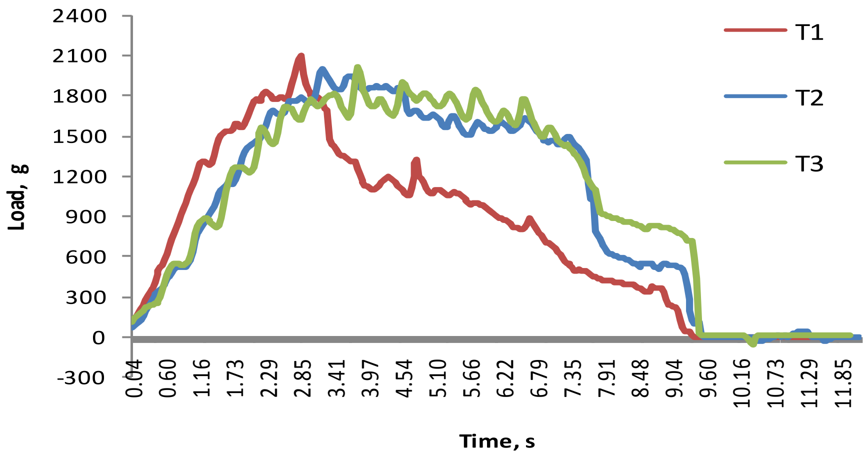

Fig. 3 Load Vs. Time of Cashew Kernels stored for three weeks in different packaging materials.

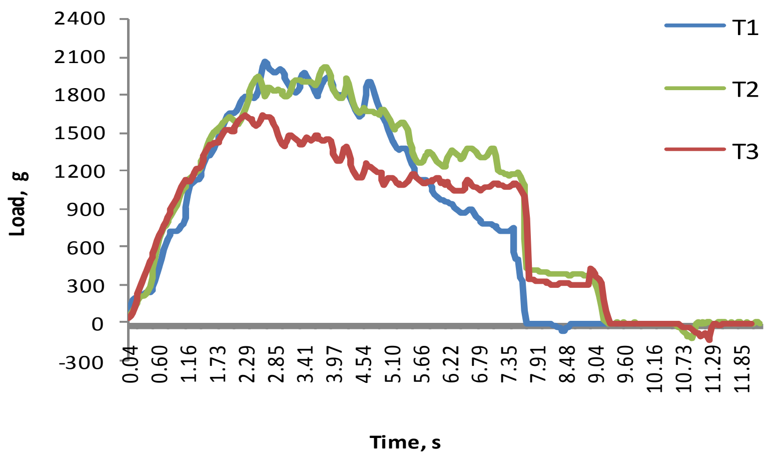

Fig. 4 Load Vs. Time of Cashew Kernels stored for four weeks in different packaging materials

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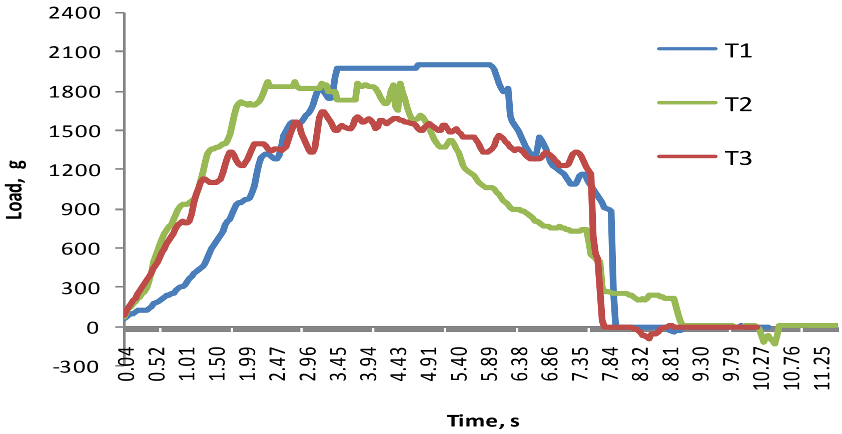

Fig. 5 Load Vs. Time of Cashew Kernels stored for five weeks in different packaging materials

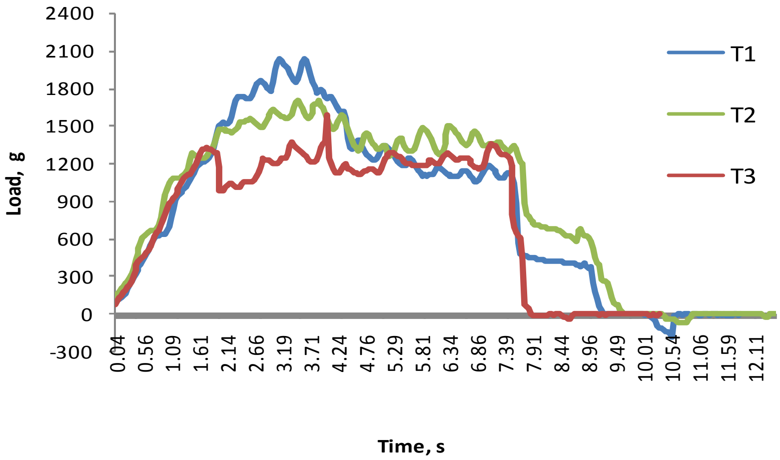

Fig. 6 Load Vs. Time of Cashew Kernels stored for six weeks in different packaging materials

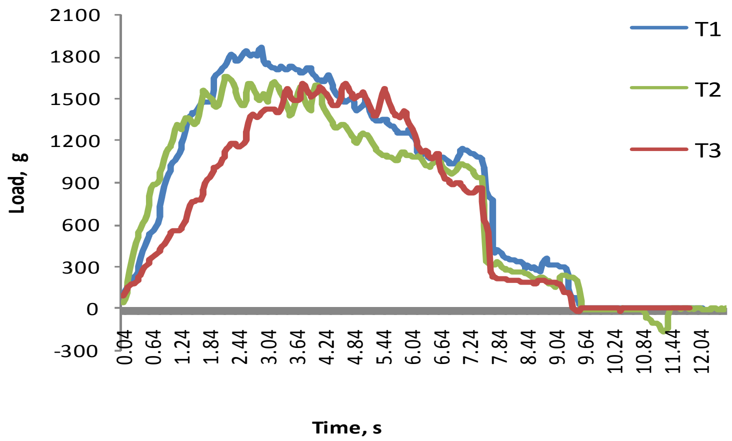

Fig. 7 Load Vs. Time of Cashew Kernels stored for seven weeks in different packaging materials

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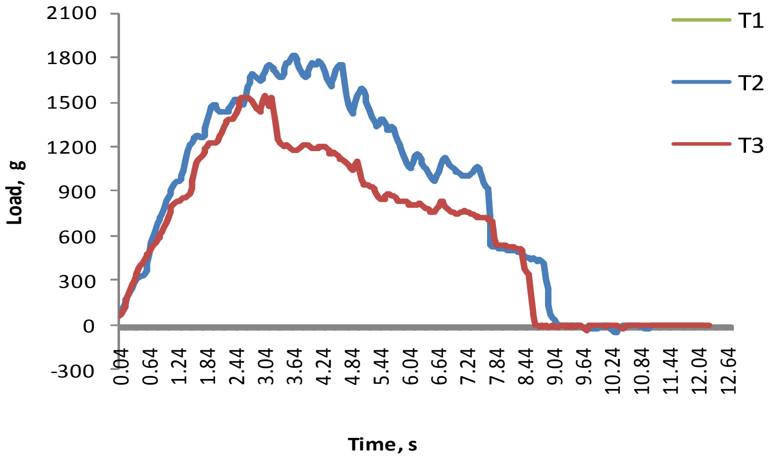

Fig. 8 Load Vs. Time of Cashew Kernels stored for eight weeks in different packaging materials

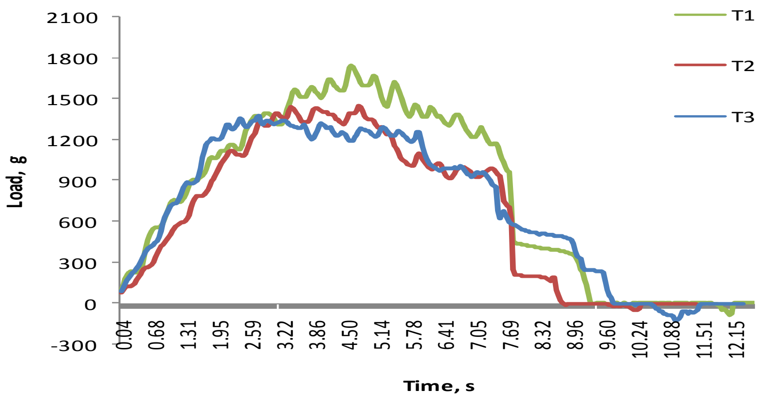

Fig. 9 Load Vs. Time of Cashew Kernels stored for nine weeks in different packaging materials

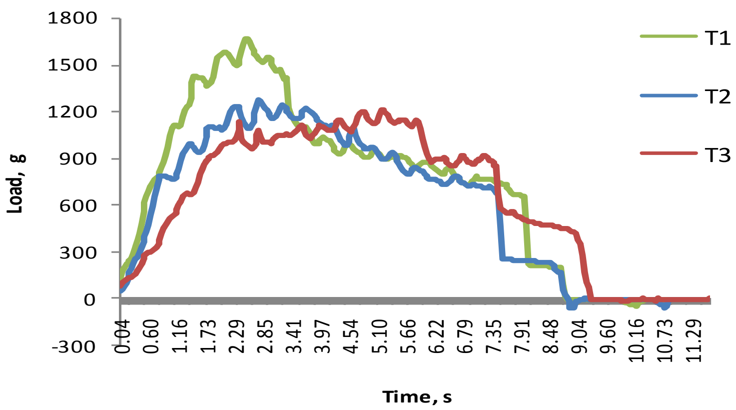

Fig. 10 Load Vs. Time of Cashew Kernels stored for ten weeks in different packaging materials

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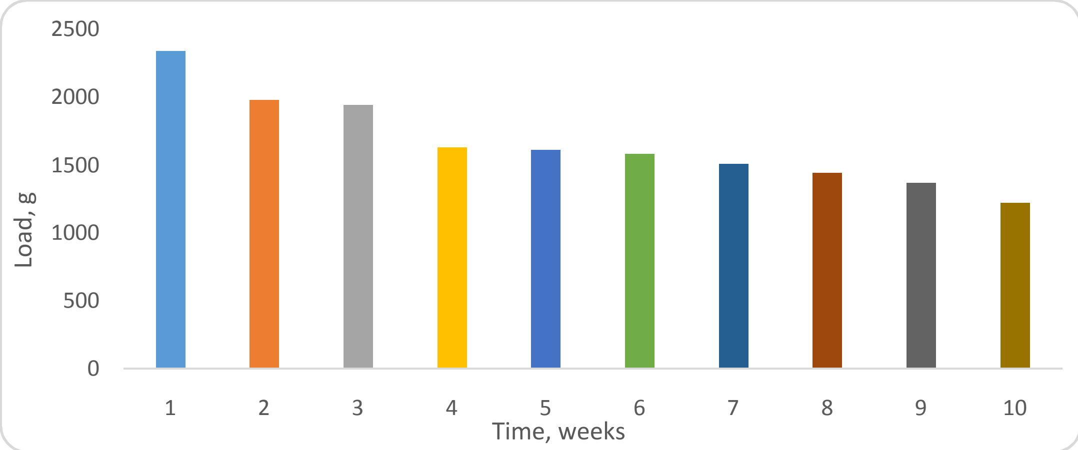

Fig. 11 Load Vs. Time of packed Cashew Kernels in 100 gauge polyethylene bag

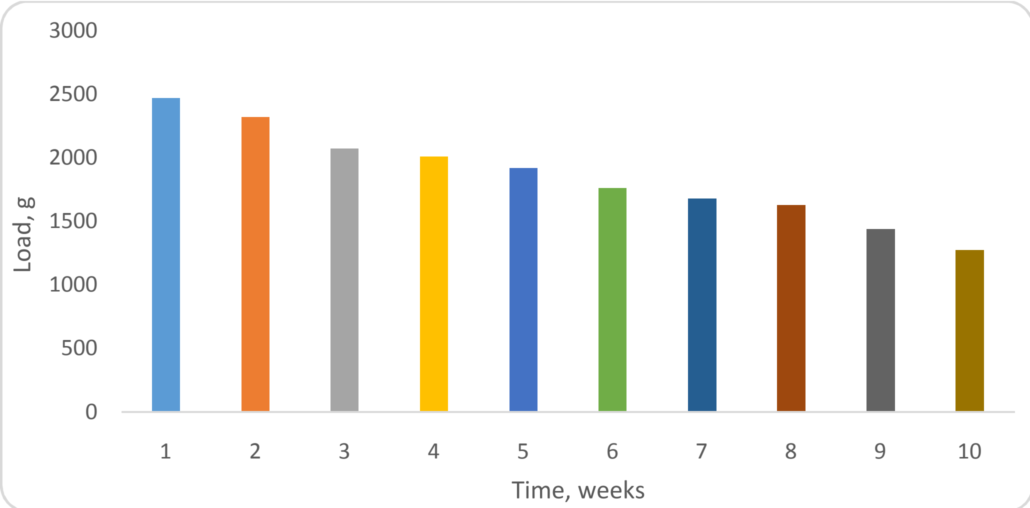

Fig. 12 Load Vs. Time of packed Cashew Kernels in 200 gauge polyethylene bag

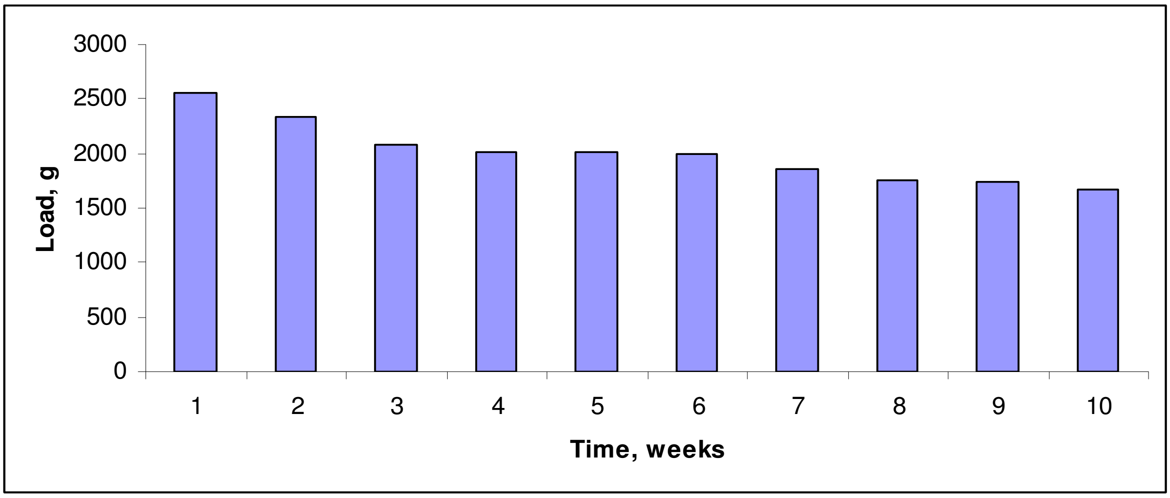

Fig. 13 Load Vs. Time of packed Cashew Kernels in 300 gauge polyethylene bag

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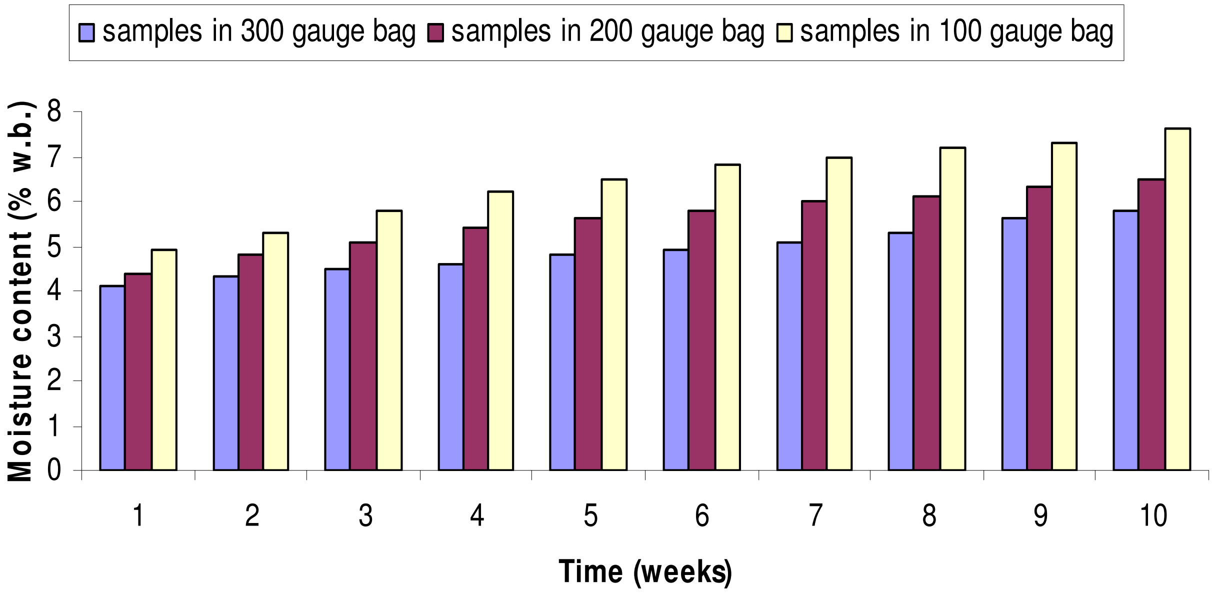

F1g. 14The moisture Profile in Polyethylene Packaging Material during storage

Table 1 Average load required to rupture the Cashew Kernels packed in different polyethylene bags.

Weeks ↓ / Load (g) →	Cashew Kernels stored in different gauges of polyethylene bags		
	100	200	300
1	2341	2470	2562
2	1979	2319	2343
3	1942	2074	2074
4	1629	2010	2016
5	1610	1920	2010
6	1580	1760	2000
7	1508	1680	1852
8	1442	1630	1764
9	1368	1442	1740
10	1210	1225	1635

Table 2 Moisture content of Cashew Kernels stored in different packaging materials.

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M. C. (% w. b.) → / Weeks ↓	Cashew Kernels stored in different gauges of polyethylene bags		
	100	200	300
1	4.9	4.4	4.1
2	5.3	4.8	4.3
3	5.8	5.1	4.5
4	6.2	5.4	4.6
5	6.5	5.6	4.8
6	6.8	5.8	4.9
7	7.0	6.0	5.1
8	7.2	6.1	5.3
9	7.3	6.3	5.6
10	7.6	6.5	5.8

IV. CONCLUSION

The conclusions drawn from results are as follow:

1. The lowest force required to rupture the cashew kernels wassample stored in 100 gauge polyethylene bag and highest for sample stored in 300 gauge polyethylene bag at the end of storage period.
2. The 300 gauge polyethylene bag is suitable for safe storage of Cashew Kernels up to a period of 9 to 10 weeks as compared to 100 gauge 200 gauge polyethylene bags.

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