Effect of Tea bag materials on physical and chemical quality parameters of Black Tea during storage

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Introduction

The tea (*Camellia sinensis*) produced in Sri Lanka is popular as "Ceylon tea" and has a higher demand as 'best quality tea' in the international trade. Packing tea into bags in many forms has become very popular because of convenience and it can be considered as an effective form of value addition. Though tea bags are used as packaging strategy in order to protect the quality parameters of tea during storage, while extending the shelf life, there are many quality claims against tea bag materials. The other bad news is that paper tea bags may be just as bad, or worse, than the plastic ones because many of them are treated with epichlorohydrin, a compound mainly used in the production of epoxy resins. The purpose of this research was to evaluate effect of different types of tea bag packaging materials on physical and chemical parameters of tea and selecting best tea bag packaging material.

Methodology

There are three types of tea bag materials as Paper, Soilon and Nylon that used to export tea in Sri Lanka, were used for this research. Those tea bags contained black tea with same manufacturing date, and also they were received from same tea exporting company. Each tea bag was consisting with Broken Orange Pekoe Fannings (BOPF) grade of black tea and tea bags were in same shape, size and same weight (2.5g) of tea. Each type of tea bag was packed in same size of sealed cardboard boxes and they were stored in normal room temperature. Each box was consisted with 25 tea bags.

Tea bags were stored for three months duration. Every experiment was conducted three times at same time intervals in each month of during storage period and data was collected in each month. Experiments were conducted using selected physical and chemical quality parameters of black tea. Moisture content, dry matter, brightness, total colour were measure as physical quality parameters and total polyphenols, caffeine, thearubigin, theaflavin and thearubigin to theaflavin ratio was measured as chemical quality parameters. Three replicates were carried out for each type of materials in each experiment. Every experiment was conducted according to ISO procedures recommended for black tea.

All data were expressed using descriptive statistics as means, standard deviations and coefficient of variations of triplicate measurements and analysed by using Minitab 16 software. Significant effects were tested by conducting two sample t-tests for each packaging materials by comparing with the initial data set of each material separately. Values of $P<0.05$ were considered as significantly different ($\alpha=0.05$).

Results and Discussion

Table 1: Means, SD, SE, and Coef.Var. of Chemical Components of Tea Samples with Different Tea Bag Materials

Quality Parameter	Material	Mean	St. Dev.	SE Mean	Coef. Var.
Moisture	1	7.917	0.483	0.837	10.58
	2	7.760	0.556	7.24	7.24
	3	7.627	0.732	9.60	9.60
Dry matter	1	89.767	0.527	0.914	1.02
	2	90.210	0.320	0.555	0.62
	3	90.000	0.381	0.660	0.73
Theaflavin	1	0.328	0.028	0.048	14.72
	2	0.375	0.009	0.016	4.38
	3	0.356	0.018	0.031	8.61
Thearubigin	1	16.320	0.769	1.333	8.17
	2	16.607	0.299	1.517	3.11
	3	17.063	0.407	0.704	4.13
TF/TR	1	0.0197	0.0029	0.0051	26.09
	2	0.0223	0.0009	0.0015	6.84
	3	0.0203	0.0007	0.0012	5.68
Brightness	1	16.68	1.10	1.91	11.47
	2	17.52	1.26	2.18	12.41
	3	14.858	0.368	0.638	4.30
Total Colour	1	5.503	0.085	0.147	2.67
	2	5.203	0.379	0.656	12.61
	3	5.466	0.404	0.700	12.80

Total Polyphenol	1	12.262	0.051	0.087	0.71
	2	13.239	0.039	0.067	0.51
	3	12.813	0.087	0.151	1.18
Caffeine	1	1.977	0.059	0.1027	5.19
	2	2.007	0.022	0.0371	1.85
	3	2.047	0.057	0.0982	4.80

Material 1-Paper Material 2-Soilon Material 3-Nylon

The highest mean value of moisture content of black tea contained in paper tea bags were 7.917 %, ranged from 06.97 - 8.56 % with soilon and nylon tea bags which are having the lower change of moisture 7.04 - 8.09 % and 6.79 - 8.15 % respectively and coefficient of variation 10.58 %. Soilon tea bags having lowest moisture change range from 6.79 – 8.15 % and coefficient of variation 7.24 %. High moisture content aids microbial activities, oxidation – reduction processes and fungal growth. The variation in the moisture may be attributed to the degree of drying type and nature of tea involved (Kumar *et al*., 2005).According to this study it is because of the different textures of these three materials affect for the absorption of the moisture during the storage. Another important factor is use of packaging material to maintain a constant moisture level during storage of commercial tea samples, so moisture content in commercial tea is an essential parameter of quality (Yao *et al*., 2006).

The results of the dry matter analysis are as shown in Table 1, lowest changes of dry matter content was resulted from soilon tea bags which having lowest coefficient of variation 0.62 %.

The theaflavin (TF) content analysis results are shown in Table 1, which follows the order Soilon > Nylon> Paper with a means of 0.375 %, ranging from 0.394 -0.363 % and coefficient of variation 4.38 %.

The results of TF/TR content in Table 1, showed that soilon tea bag had the least change of value of TF/TR ratio of mean 0.0223, ranged from 0.024 - 0.021 with lowest mean 0.0197 of the paper tea bags ranging from 0.024 - 0.014 while nylon tea bag having the mean distribution value of 0.0203 TF/TR content ranged from 0.024 - 0.019 with coefficient of variation 5.68 %, which is low when compared with the paper and soilon, 26.09 % and 6.84% respectively.

Least change of brightness during storage was obtained from nylon tea bags having lowest coefficient of variation 4.3%.

According to Table 1, lowest change of the total colour was obtained from nylon tea bags, mean 5.503, ranged from 5.53 – 5.643 having coefficient of variation 2.67 % compared to soilon and nylon tea bags means 5.203 and 5.466 are ranged from 5.36 - 4.483 and 5.023 – 6.273 with coefficient of variations 12.61 % and 12.80 %.The TR content gives the tea liquor its depth of colour and more TR content means very strong and coloured liquor with less briskness as caffeine along with TF contribute towards briskness. This method also includes the measurement of total colour, which is the combined contribution of colour from TF and TR present in the tea liquor (Borah and Bhuyan).

The results of the Total polyphenol analysis as shown in Table 1 with mean distribution of paper tea bags 12.34 %, ranged from 12.34 – 12.167 % and coefficient of variation 0.7 %, soilon and nylon tea bags having lower total polyphenol changes, ranged from 13.313 – 13.181% and 12.940 – 12.646 % with their means and coefficient of variances 13.239 %, 12.813 % and 0.5 % and 1.18 % respectively and least changes of total polyphenol was obtained from soilon tea bags.

The results of the caffeine analysis as shown in Table 1 with mean distribution of paper tea bags 1.977 %, ranged from 2.053 – 1.86 % and coefficient of variation 5.19 %, soilon and nylon tea bags having lower caffeine changes, ranged from 2.046 – 1.973 % and 2.133 – 1.940 % with their means and coefficient of variances 2.007 %, 2.047 % and 1.85 % and 4.80 % respectively and least changes of caffeine were obtained from soilon tea bags.

Table 2: Significant Effects of the Tea Bag Materials

Material	P Values									
	Time	MC	DM	TF	TR	TF/TR	TC	Br.	TPP	Caff.
Paper	2	0.049	0.000	0.448	0.305	0.212	0.971	0.665	0.139	0.020
Paper	3	0.017	0.041	0.117	0.019	0.025	0.431	0.499	0.023	0.000
Soilon	2	0.017	0.088	0.716	0.421	0.571	0.719	0.603	0.000	0.048
Soilon	3	0.007	0.080	0.633	0.114	0.377	0.813	0.307	0.003	0.015
Nylon	2	0.077	0.190	0.335	0.181	0.248	0.211	0.874	0.073	0.035
Nylon	3	0.050	0.161	0.118	0.048	0.076	0.571	0.097	0.004	0.002

2- 60 days (2nd month) **3**-60 days (3rd month)

According to two sample t-test, effects are significant ($P<0.05$) for the quality parameters such as moisture content, dry matter content, thearubigin, total polyphenol and caffeine in paper tea bags. Nylon tea bags showed significant effects for the thearubigin, total polyphenol and caffeine. Soilon tea bags showed significant effects for the moisture, total polyphenol and caffeine.

Highest numbers of significant effects for the quality parameters are detected from paper tea bags and minimum numbers of significant effects were detected from soilon tea bags.Descriptive analysis showed highest changes of quality parameters in paper bags and least changes of quality parameters in soilon tea bags.

According to descriptive analysis, t-test effects of changes of quality parameters were vary as Paper> Nylon> Soilon respectively.

Conclusion

The effects of packaging materials on each quality parameters are varied with the type of material. These variations are mainly due to nature and permeability of the material. Permeable materials allow moisture absorption with time if the moisture levels of the storage environment are not properly controlled. Moisture absorption is high in nylon and paper materials compared to soilon. Changes in Quality parameters of paper and nylon materials are comparatively higher than soilon. Compared to nylon and paper materials, soilon showed minimum significant changes of the quality parameters with minimum significant effects ($P<0.05$). According to descriptive and t-tests, can conclude 'Soilon' is the 'best' material for tea bags for these three months studying period.

References

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