Amit Kumar *et al*, International Journal of Advances in Agricultural Science and Technology,
Vol.6 Issue.7, July-2019, pg. 117-128
ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

Effect of Pretreatment and Packaging Materials on Quality of Spinach Powder During Storage

Amit Kumar[1]; Atul Anand Mishra[2]; Vikas Kumar[1]

Mr. Amit Kumar, Assistant Professor
School of Agriculture and Environmental Sciences
Shobhit University Gangoh Saharanpur, U.P. India
E-mail: amit.tomar371@gmail.com

Mr. Atul Anand Mishra, Assistant Professor
Department of Food Process Engineering
SHUATS Allahabad, U.P. India
E-mail: atul.mishra@shiats.edu.in

Mr. Vikas Kumar, Assistant Professor
School of Agriculture and Environmental Sciences
Shobhit University Gangoh Saharanpur, U.P. India
E-mail: Vkkumarpanwar3@gmail.com

ABSTRACT: ***The study was conducted at School of Agriculture and Environmental Sciences, Shobhit University, Gangoh, Saharanpur, U.P. to evaluate the effect of control sample (unblanched) spinach leaves and hot water blanched sample on shelf-life of spinach powder and to evaluate the effect of water treatments, chemical composition such as moisture content, fat content and ash content were carried out. Sensory analysis of colour, texture, aroma and overall acceptability were carried out according to 9 point hedonic scale. To evaluate the shelf-life of spinach powder packed in High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE) and Poly propylene (PP) packaging materials, Total plate count (TPC) and yeast & mould counts were carried out. The results showed that unblanched sample was more suitable according to fat and ash content. For moisture content hot water blanched sample was more favourate. PP excelled than HDPE and LDPE as a packaging material to store spinach powder for a long period of time. According to sensory score, hot water blanched sample was more favourate by the panelist than unblanched sample. With increase in storage period TPC and yeast & mould increased but hot water blanched sample showed less growth of TPC and yeast & mould when compared to unblanched sample. PP showed less microbial count than the HDPE and LDPE, so it is most suitable for spinach powder packaging for a long period of time.***

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

INTRODUCTION

Spinach (*Spinacia Oleracea*) is a green leafy vegetable belonging to Chenopodiaceae family and is locally known as 'Palak'. It is an annual plant which grows to a height of 30 cm. This plant needs temperate climate and survives over winter in temperate regions.

Spinach is one of the most common leafy vegetable of tropical and subtropical region and is grown widely all over the India. It is highly nutritious and available at the cheaper rate in the market compared to other leafy vegetables. Spinach is widely used in making various food products like vegetable puree, soups and baked products. The more it is refrigerated, the less are its nutrient contents. Fresh spinach, when kept in the fridge for more than a week, tends to lose almost half of its nutrients. So it is best to consume it in the least possible time **(Rahi, 1990).**

A fresh leaf of spinach which is rich source of vitamins and iron can be made available during off seasons where it is not available. Dried spinach with added nutrients can be made available to the defense personnel in areas where it is not available **(Berna, 1991).**

Spinach is one of the most nutritious and healthy greens among all vegetables. Though low in calories, it contains higher concentrations of minerals, vitamins and other phytonutrients (natural plant chemicals with human nutritional value). Recommended by nutritionists and dietitians, this food contains lower levels of cholesterol and saturated fats **(Verma, 2001).**

METHODOLOGY

Procurement of raw material

Fresh spinach leaves were procured from local market.

Preparation of sample

Fresh spinach leaves were selected and washed thoroughly under running water to remove soil and chemical residues. After washing, leaves were spread over the tray to remove excess water, pieces were kept uniform in size and they were dried at the same rate. Samples were divided in 2 parts unblanched and blanched with water.

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

PREPARATION OF SPINACH POWDER:

Collection of raw material
↓
Washing
↓
Grading/Sorting
↓
Cutting, Trimming
↓
Blanching (2-3min)
↓
Tray Drying
↓
Grinding
↓
Sieving
↓
Packaging
↓
Storage

Fig. Preparation of Spinach Powder

Nutritional analysis

The moisture, ash, and fat of the spinach powder were determined according to the standards of AOAC (2010).

Sensory evaluation

Spinach powder was evaluated by a panel of ten untrained judges for the sensory attributes of color, texture, aroma and overall acceptability using a nine point structured hedonic scale. It scores was 9 = extremely liked, 8 = very much liked, 7 = Moderately liked, 6 = Slightly liked, 5 = neither liked nor disliked, 4 = Slightly disliked, 3 = Moderately disliked, 2 = Very much disliked and 1 = Extremely disliked.

Microbial Analysis

The microbial characteristics of were also determined for storage period of spinach powder.

Statistical analysis

Data were analyzed using analysis of variance. The mean scores were analyzed using analysis of variance (ANOVA) method and difference separated using F- test. Significance was accepted at $p \leq 0.05$.

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

RESULTS AND DISCUSSION

The Experiments were conducted to study the effect of pretreatment and packaging materials on quality of Spinach Powder during storage. Dried spinach samples were ground to powder in a domestic grinder. Spinach Powder samples were packed in HDPE, LDPE and PP bags and stored at room temperature for 60 days.

Preparation of Spinach powder

Spinach powder was prepared and packed in three different packaging materials (HDPE, LDPE and PP) and stored for 60 days. During storage period different analyses were done.

Initial moisture content of Spinach leaves

The initial moisture content of the fresh Spinach leaves was found in the range of 91.2 to 92.5 (% w.b.) and the average value of moisture content was 91.2 (% w.b.) and the same was observed throughout the study.

Effect of pretreatment and packaging materials on physico-chemical properties of Spinach Powder

Table 1 Effect of packaging materials on moisture content of unblanched spinach powder

Packaging materials	Moisture Content (%)				
	0 day	15 days	30 days	45 days	60 days
HDPE	3.35	4.12	4.45	4.83	5.21
LDPE	3.35	5.22	5.56	5.92	6.37
PP	3.35	4.02	4.32	4.74	5.18
F-test	NS	S	S	S	S
S. Ed. (±)	0.414	0.090	0.090	0.041	0.093
C. D.(P=0.05)	0.978	0.212	0.212	0.097	0.219

Table 2 Effect of packaging materials on moisture content of water blanched spinach powder

Packaging materials	Moisture Content (%)				
	0 day	15 days	30 days	45 days	60 days
HDPE	3.04	3.72	3.94	4.13	4.42
LDPE	3.04	4.46	4.68	4.81	5.02
PP	3.04	3.67	3.88	4.07	4.37
F-test	NS	S	S	S	S
S. Ed. (±)	0.019	0.008	0.009	0.012	0.009
C. D.(P=0.05)	0.045	0.019	0.022	0.029	0.022

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

Table 3: Effect of packaging materials on fat content of unblanched spinach powder

Packaging materials	Fat Content (%)				
	0 day	15 days	30 days	45 days	60 days
HDPE	2.42	2.24	2.1	1.85	1.72
LDPE	2.42	2.21	2.06	1.7	1.54
PP	2.42	2.29	2.21	2.03	1.81
F-test	NS	S	S	S	S
S. Ed. (±)	0.172	0.008	0.021	0.021	0.008
C. D.(P=0.05)	0.405	0.019	0.048	0.048	0.019

Table 4: Effect of packaging materials on fat content of water blanched spinach powder

Packaging materials	Fat Content (%)				
	0 day	15 days	30 days	45 days	60 days
HDPE	2.28	2.12	2.01	1.74	1.53
LDPE	2.28	2.06	1.85	1.67	1.4
PP	2.28	2.18	2.14	2.02	1.78
F-test	NS	S	S	S	S
S. Ed. (±)	0.450	0.025	0.064	0.016	0.012
C. D.(P=0.05)	1.061	0.059	0.150	0.039	0.029

Table 5 Effect of packaging materials on ash content of unblanched spinach powder

Packaging materials	Ash Content (%)				
	0 day	15 days	30 days	45 days	60 days
HDPE	20.81	20.75	20.62	20.31	20.02
LDPE	20.81	20.45	20.21	19.87	19.61
PP	20.81	20.76	20.65	20.4	20.15
F-test	NS	S	S	S	S
S. Ed. (±)	43.297	0.024	0.097	0.128	0.043
C. D.(P=0.05)	102.181	0.056	0.228	0.303	0.102

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

Table 6: Effect of packaging materials on ash content of water blanched spinach powder

Packaging materials	Ash Content (%)				
	0 day	15 days	30 days	45 days	60 days
HDPE	18.77	18.77	18.64	18.21	17.94
LDPE	18.77	18.54	18.41	18.16	17.82
PP	18.77	18.81	18.67	18.22	18.05
F-test	NS	S	S	S	S
S. Ed. (±)	0.469	0.017	0.014	0.008	0.021
C. D.(P=0.05)	1.107	0.040	0.033	0.019	0.048

Sensory Evaluation

Table 7: Effect of packaging materials on colour of unblanched spinach powder

Packaging materials	Colour				
	0 day	15 days	30 days	45 days	60 days
HDPE	6.72	6.23	5.54	5.27	5.13
LDPE	6.72	6.13	5.36	5.18	4.96
PP	6.72	6.33	5.86	5.45	5.23
F-test	NS	S	S	S	S
S. Ed. (±)	0.428	0.039	0.016	0.094	0.115
C. D.(P=0.05)	1.009	0.091	0.039	0.222	0.273

Table 8: Effect of packaging materials on colour of water blanched spinach powder

Packaging materials	Colour				
	0 day	15 days	30 days	45 days	60 days
HDPE	7.23	6.96	6.36	6.23	5.54
LDPE	7.23	6.86	6.27	5.96	5.45
PP	7.23	7.09	6.54	6.36	5.86
F-test	NS	S	S	S	S
S. Ed. (±)	0.432	0.014	0.017	0.021	0.012
C. D.(P=0.05)	1.020	0.033	0.040	0.048	0.029

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

Table 9: Effect of packaging materials on texture of unblanched spinach powder

Packaging materials	Texture				
	0 day	15 days	30 days	45 days	60 days
HDPE	5.82	5.74	5.63	5.52	5.36
LDPE	5.82	5.63	5.54	5.45	5.27
PP	5.82	5.81	5.76	5.63	5.52
F-test	NS	S	S	S	S
S. Ed. (±)	0.108	0.054	0.017	0.021	0.021
C. D.(P=0.05)	0.256	0.128	0.040	0.048	0.048

Table 10: Effect of packaging materials on texture of water blanched spinach powder

Packaging materials	Texture				
	0 day	15 days	30 days	45 days	60 days
HDPE	6.23	5.96	5.63	5.62	5.45
LDPE	6.23	5.84	5.54	5.45	5.33
PP	6.23	6.13	5.87	5.71	5.63
F-test	NS	S	S	S	S
S. Ed. (±)	0.043	0.017	0.017	0.021	0.012
C. D.(P=0.05)	0.102	0.040	0.040	0.048	0.029

Table 11: Effect of packaging materials on aroma of unblanched spinach powder

Packaging materials	Aroma				
	0 day	15 days	30 days	45 days	60 days
HDPE	6.74	6.54	6.52	6.33	6.27
LDPE	6.74	6.45	6.45	6.3	5.86
PP	6.74	6.63	6.58	6.46	6.36
F-test	NS	S	S	S	S
S. Ed. (±)	0.432	0.019	0.009	0.056	0.016
C. D.(P=0.05)	1.020	0.045	0.022	0.131	0.039

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

Table 12: Effect of packaging materials on aroma of water blanched spinach powder

Packaging materials	Aroma				
	0 day	15 days	30 days	45 days	60 days
HDPE	6.54	6.36	6.3	6.13	5.86
LDPE	6.54	6.33	6.27	5.96	5.74
PP	6.54	6.45	6.38	6.27	5.92
F-test	NS	S	S	S	S
S. Ed. (±)	0.086	0.021	0.017	0.014	0.012
C. D.(P=0.05)	0.204	0.048	0.040	0.033	0.029

Table 13: Effect of packaging materials on overall acceptability of unblanched spinach powder

Packaging materials	Overall Acceptability				
	0 day	15 days	30 days	45 days	60 days
HDPE	6.23	6.1	5.75	5.52	5.36
LDPE	6.23	6.06	5.54	5.45	5.27
PP	6.23	6.18	5.86	5.61	5.45
F-test	NS	S	S	S	S
S. Ed. (±)	0.425	0.026	0.043	0.045	0.009
C. D.(P=0.05)	1.003	0.062	0.102	0.106	0.022

Table 14: Effect of packaging materials on overall acceptability of water blanched spinach powder

Packaging materials	Overall Acceptability				
	0 day	15 days	30 days	45 days	60 days
HDPE	6.58	6.36	5.84	5.56	5.33
LDPE	6.58	6.27	5.63	5.48	5.3
PP	6.58	6.45	5.96	5.68	5.54
F-test	NS	S	S	S	S
S. Ed. (±)	0.428	0.022	0.022	0.008	0.045
C. D.(P=0.05)	1.009	0.051	0.051	0.019	0.106

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

Table 15: Effect of packaging materials on total plate count (TPC) of unblanched spinach powder

Packaging materials	TPC (cfu/g)				
	0 day	**15 days**	**30 days**	**45 days**	**60 days**
HDPE	0	21×10^2	38×10^2	60×10^2	78×10^2
LDPE	0	28×10^2	46×10^2	68×10^2	85×10^2
PP	0	16×10^2	34×10^2	55×10^2	72×10^2
F-test	----	S	S	S	S
S. Ed. (±)	----	0.408	0.408	0.816	0.816
C. D.(P=0.05)	----	0.963	0.963	1.927	1.927

Table 16: Effect of packaging materials on total plate count (TPC) of water blanched spinach powder

Packaging materials	TPC (cfu/g)				
	0 day	**15 days**	**30 days**	**45 days**	**60 days**
HDPE	0	8×10^2	14×10^2	32×10^2	42×10^2
LDPE	0	11×10^2	22×10^2	38×10^2	48×10^2
PP	0	6×10^2	7×10^2	27×10^2	35×10^2
F-test	----	S	S	S	S
S. Ed. (±)	----	0.236	0.408	0.850	0.408
C. D.(P=0.05)	----	0.556	0.963	2.006	0.963

Table 17: Effect of packaging materials on yeast and mould count of unblanched spinach powder

Packaging materials	Yeast & Mould (cfu/g)				
	0 day	**15 days**	**30 days**	**45 days**	**60 days**
HDPE	0	5×10^2	7×10^2	10×10^2	13×10^2
LDPE	0	6×10^2	9×10^2	12×10^2	16×10^2
PP	0	4×10^2	6×10^2	8×10^2	11×10^2
F-test	----	S	S	S	S
S. Ed. (±)	----	0.205	0.294	0.408	0.471
C. D.(P=0.05)	----	0.485	0.695	0.963	1.113

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

Table 18: Effect of packaging materials on yeast and mould count of water blanched spinach powder

Packaging materials	Yeast & Mould (cfu/g)				
	0 day	15 days	30 days	45 days	60 days
HDPE	0	3×10^2	5×10^2	8×10^2	11×10^2
LDPE	0	4×10^2	6×10^2	9×10^2	14×10^2
PP	0	2×10^2	4×10^2	6×10^2	10×10^2
F-test	----	S	S	S	S
S. Ed. (±)	----	0.294	0.356	0.432	0.566
C. D. (P=0.05)	----	0.695	0.840	1.020	1.335

SUMMARY AND CONCLUSION

Summary:

Spinach leaves were pretreated as unblanched and water blanched samples and was subjected to drying for the preparation of spinach powder and prepared powder was packed in different packaging materials (HDPE, LDPE & PP) in order to evaluate quality attributes and shelf-life.

The findings are summarized below:

1. The initial moisture content of the fresh spinach leaves was found in the range of 91.2 to 92.5% wet basis.

2. The spinach leaves were dried for the preparation of spinach powder, prepared powder was packed in HDPE, LDPE and PP for 60 days.

3. The maximum moisture content was 6.37% for unblanched spinach powder while minimum was found 4.37% for water blanched spinach powder.

4. The fat content was maximum 1.8% for unblanched spinach powder while it was minimum 1.4% in water blanched spinach powder.

5. There was slight decrease in ash content for both the unblanched and water blanched samples. The minimum ash 17.82% was for water blanched sample while it was maximum 20.15% in unblanched spinach powder.

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

The sensory analysis was also done on 9 point hedonic scale. The maximum overall acceptability was given to the sample packed in PP while minimum overall acceptability was given to the sample packed in LDPE. The microbial analysis was also done for shelf-life study. Unblanched sample was not acceptable after 30 days but water blanched sample was acceptable up to 60 days.

Conclusions:

From the study it was concluded that the moisture content of the spinach powder was affected by pretreatments and packaging materials. The fat content decreased with increase in storage period for both the samples. Ash content was not much influenced by any of the treatment. Microbial count increased with increase in time (days). The water blanched samples packed in PP were the most accepted sample of spinach powder with response to sensory score.

REFERENCES

[1]. Aykroyd, (1956) Comparison of the effects of crude extract of spinach beet leaves.
[2]. Berna (1991) Effects of dipping and washing pretreatment on microwave drying of grapes. Journal of Food Process Engineering.15-25.
[3]. Bengt L. Bengtson, Ingmar Bosund and Bertil Hylmo, (1996) Mineral salts and oxalate content in spinach leaves as a function of development stage, Volume 115, Issue 3, Article first published online: 24 Jan 2007.
[4]. Jain, R. K., Srivastav P.P. and Das H. (2000) Dehydration characteristics of spinach in an air recirculatory tray dryer. J. Agril. Engng. 37(3): 33-39.
[5]. Karamchandani, A., and Rawat, V. (2009) Development of dehydrated spinach product Thesis, B. Tech. G.B. Pant University of Agriculture and Technology, Pantnagar, India.
[6]. King V. An-Erl (2006) Chlorophyll stability in spinach dehydrated by Kay drier by freeze drying and controlled 1000 temperature vacuum dehydration.
[7]. Kim M. and Kim T. (2003) Studies on the changes in food dough containing spinach powder. Journal of food processing and preservation 29(5) 540-555.
[8]. Lakshmi and Vimala, (2000) Nutritive value of dehydrated green leafy vegetable powders. Journal of food science & Technology.
[9]. Linda J., Van E, Arthur R., and Grossman D.B., Inversion and Martin W.D. (1980) Isolation and characterization of Calmodulin from spinach leave in vitro translation mixture.
[10]. Masuda and Ombware (2005) Effect of acid scarification with PEG, Nacl or sea water as osmoticum and dehydration on spinach seed germination at 300°C. Journal of the Japanese society for horticultural since 74(2) 134-138.
[11]. Maria, E.P., Danial, R.G. and Andrea, M.P. (2002) Fresh cut spinach quality as influenced by spin drying parameters. J. Food Quality 26 (3): 231-242.
[12]. Nisha, P., Singhal, R.S. and Pandit, A.B. (2004) A study on the degradation kinetics of visual green colour in spinach (Spinacea oleracea L.) and the effect of salt there in. J. Food Engng. 64: 135-142.
[13]. Oladele, O.O. and Aborisade, A.T. (2005) Influence of different drying methods and storage on quality on Indian Spinach. American J. Food Technol. 4(2): 66-70.

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

[14]. Pandian S.G. (2001) Vacuum drying of spinach B. Tech. Project report, Allahabad Agricultural Institute-Deemed University.

[15]. Padvi, C.A. (2009) Drying characteristics and process optimization of spinach (Spinach oleracea L.) using response surface methodology. Thesis, M. Tech. G.B. Pant University of Agriculture and Technology, Pantnagar.

[16]. Rahi and Shailendra (1990) Effect of sun drying on vegetables. Journal of food Engineering 20:385-389.

[17]. Ragab (1987) Studies as freezing partially dehydrated spinach. Food science department faculty of Ag Zafazing University Egypt.

[18]. Singh D and Pushkar (2005) Evaluated quality & rehydration characteristic of different pretreatment methods.

[19]. Tan, C.T. and Francis, F.J. (2006) Effect of processing temperature on pigments and colour of spinach. J. Food Technol. 27(3): 232-241.

[20]. Verma- T and Raghvanshi R.S. (2001) Combating micronutrient deficiency anemia & vitamin A deficiency All India co-ordinate Research Programme in ICAR.

[21]. Waskar D.P; Gaikwad R.S. Damane S.V. (1998) Studies on various methods of dehydration of leafy vegetables. Orissa-Journal of Horticulture 1998. 26;2; 29-30.

[22]. Yadav, S. K. and Sehgal, S. (1997) Effect on home processing on ascorbic acid and beta-carotene content of amaranthus and Spinach leaves. Plant food for Human Nutrition. 47 (2), 25-131.

