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Physico-chemical Properties Raw Avocado Pulp and Optimized Spray Dried Avocado Milk Shake Powder

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Abstract: A study was conducted on formulation of spray dried avocado milk shake powder. Avocado pulp were blended with skim milk, skim milk powder (SMP) and honey were prepared & spray dried. The raw avocado fruit pulp contains moisture 72.5%, bulk density 0.712 g/cc, color value (L^*, a^* & b^*) 49.35, -3.42 & 34.95, pH (6.35), protein (2%), fat (15.31%), fibre (6.8%), ash (1.54%) and carbohydrate (1.85%), respectively. While the optimized avocado milk shake powder had the moisture 4.32%, bulk density 0.371 g/cc, color value (L^*, a^* & b^*) 93.9, -0.501 & 4.35, pH (6.32), protein (24.30 %), fat (1.20%), fibre (1.39%), ash (6.20%) and carbohydrate (62.59%), respectively. The powder was stored in Metalized polyester pouch under ambient conditions for 3 months and the physico-chemical properties, sensory and microbial analysis were studied for every 15 days if interval. It was observed that the quality of the powder had not deteriorated during the storage period of 90 days.

Keywords: Avocado pulp , Skim milk, Skim milk powder, Spray dryer

1. INTRODUCTION

Avocados are native to Central and South America they have been cultivated in this region since 8,000 BC. In the mid-17th century, they were introduced to Jamaica and spread through the Asian tropical regions in the mid-1800s. According to scientific classification, the avocados belong, to the kingdom: *plantae*, family: *lauraceae*, genus: *persea*, species: *americana* with bionomial name *Persea americana* Mill (Orhevba *et al*., 2011).

The avocado is useful in human nutrition as a source of various nutrients and especially as source of energy and monounsaturated fatty acids. At about 70% of total fruit weight correspond to the pulp with an average of 6.94 g of carbohydrates, 17.34 g of fat, 2.08 g of proteins, 2.72 g of fibers, in 100 g of fresh pulp (Favier *et al*., 1999).

The avocado pulp contains lipophilic acetogenins that exhibit the highest antioxidant capacity (Bhuyan *et al*., 2019).The avocado pulp has been used to produce commercial oils to substitute for olive oil, with which it shares similarities such as being extracted from the fruit pulp and having some physicochemical properties such as fatty acid composition, especially oleic acid (Canto *et al*., 1980; Tango *et al*., 2004). These oils are rich in omega-9 fatty acids, which may have beneficial effects to health in relation to the prevention of cardiovascular diseases (Ahmed *et al*., 1990; Rebollo *et al*., 1998).

Avocados are good source of Vitamin K, dietary fiber, Vitamin B6, Vitamin C, Folate

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and copper. Avocados are also a good source of potassium: they are higher in potassium than a medium banana. Avocado also contains essential nutrients such as carbohydrates, sugar, soluble and insoluble fiber; avocado is also good source of oil containing monounsaturated fat, its oil contents varies depending on its varieties and the period of extraction of oil by cold-press process. Avocado is a rich source of mineral (Batista *et al*., 1993). High avocado intake has been shown to have a beneficial effect on blood serum cholesterol levels (USDA, 2011)

The spray dryer operating conditions and response variables are very important to produce the maximum powder efficiency and yield. These response variables were selected as they were important indicators of microsphere functionality and process efficiency. Factors that can significantly affect the spray drying process and product characteristics include the feed rate, atomizing wheel speed, dryer inlet and outlet air temperatures and drying air humidity. Spray dryer inlet temperatures had a more direct effect on the drying process, with droplet drying rates positively related to inlet air temperatures used (Phisut, 2012).

Fruit milk shake is dried using a variety of methods, including hot air drying, freeze drying, drum drying, foam mat drying, spray drying, and vacuum drying. The process of spray drying is widely employed in the food industry to turn a variety of fruit milk shake into powder. spray drying preserves nutritional properties, producing powders of high quality. By applying heat to the feed product and regulating the humidity of the drying medium, spray drying works by removing moisture, the feed is sprayed into a heated environment to encourage the evaporation of moisture, which improves the drying rate (Anandharamakrishnan *et al*., 2007).

Shelf life is generally defined as a definite length of time after processing and packaging during which the food product attains a required level of quality under well-defined storage conditions (Nicoli, 2012). This required quality level makes the product acceptable for consumption. Shelf -life analysis is a common practice used to evaluate the quality and stability of a given food during the storage period. In fact, careful evaluation of shelf life ensures the consumers in getting a high-quality experience from food (Tian *et al*., 2019). The food industry often processes liquid products into powder for facilitating easier transportation, preservation, and storage (Nnaedozie *et al*., 2019).

2. MATERIALS AND METHODS

The present study was planned and carried out after detailed review of published literature as discussed in the previous chapter. The materials used and the methodologies adopted for avocado milk shake, spray drying process, estimation of physico-chemical properties, optimization process of spray drying and storage studies of the avocado milk shake powder are described in this chapter.

2.1. Raw materials

Avocado Fruit

Fresh avocado (*Persea americana* Mill) was procured from the local market, Bengaluru, Karnataka, India. The fruits were selected according to the uniformity in size, ripeness, colour and freshness.

Skim Milk Powder

Commercially available "HERITAGE" brand of skim milk powder manufactured by Heritage foods limited. The carrier material used for experiments are skimmed milk powder were procured from local market Bengaluru.

Spray dried avocado milk shake powder extraction

The avocado milk shake (plate 1) was spray dried at different levels of total solids (17, 19 and 21 per cent), and homogenized. To achieve best quality product, the spray dryer (plate 2) was operated at predetermined spray drying conditions at different inlet air temperatures (140, 150 and 160) different feed rate (10, 11 and 12 rpm). The Spray dried avocado milk shake powder was collected from stainless steel cyclone in a metalized polyester packaging material plate 3. It was packed in pouch and stored at room temperature for further analysis.

Plate 1: Avocado milk shake

Plate 2: Tall type spray drier

Plate 3: Metalized polyester pouch

2.2. Analysis of powder properties

Bulk density and pH

The bulk density of spray dried avocado milk shake powder obtained from different treatments was measured according to the procedure described by Caparino *et al.* (2012) and Lebrun *et al.* (2012). The pH of spray dried avocado milk shake powder was measured by using digital pH meter by following standard method (Arab *et al.*, 2011). Bench-top spectrophotometer (Model: Konica Minolta; spectrophotometer CM-5) was used for the measurement of colour.

Water activity

For the water activity determination (Hygro Lab C1 bench-top meter), powder was filled in the disposable cups of the water activity meter and the sample drawer knob was turned to open position and the drawer was opened. The prepared sample was then placed in the drawer. Checked the top lip of the cup to make sure that it was free from sample residue (an over filled sample cup may contaminate the chamber's sensors). After placing the sample, reading was noted on the LCD display of the water activity meter.

Colour

Bench-top spectrophotometer (Model: Konica Minolta; spectrophotometer CM-5) was used for the measurement of colour of avocado milk shake powder. It works on the principle of focusing the light and measuring energy reflected from the sample across the entire visible spectrum. The 3-dimensional scale L^*, a^* and b^* was used

Proximate composition

The fresh avocado pulp was characterized by physicochemical methods, according to official (AOAC 2000) method through the determination of moisture, protein, fat, and ash contents in triplicate for each sample. Carbohydrates were obtained by difference 100% - (%protein +% moisture +% lipid +% ash) (sadasivam manickam *et al.*, 1992).

Storage studies of the optimized spray dried avocado milk shake powder

The storage studies were done in order to determine the shelf-life effect of the prepared

Avocado milk shake powder. The metalized polyester pouch (MP) was used for storing the optimized product. The storage studies were conducted for three months at ambient conditions. Samples were analyzed periodically at 0, 15, 30, 45, 60, 75 and 90 days for physico-chemical parameters.

Assessment of physico-chemical parameters of the optimized avocado milk shake powder during storage

The physico-chemical parameters of the optimized spray dried avocado milk shake powder such as moisture content, pH, bulk density, water activity, overall acceptability and microbial analysis using standard method AOAC (2000) and (FSSAI 2012) during storage.

Statistical Analysis

The data obtained on effect of inlet air temperature, feed flow tare and total solids on the spray dried avocado milk shake powder characteristics were statistically analyzed as per the design (CRD) to determine the significant differences among treatments using OPSTAT Software. The data for the storage studies like moisture content, bulk density, water activity, pH, colour values, microbial analysis and sensory properties of developed products was statistically analyzed according to the design CRD, in order to determine the significant differences in the responses during storage.

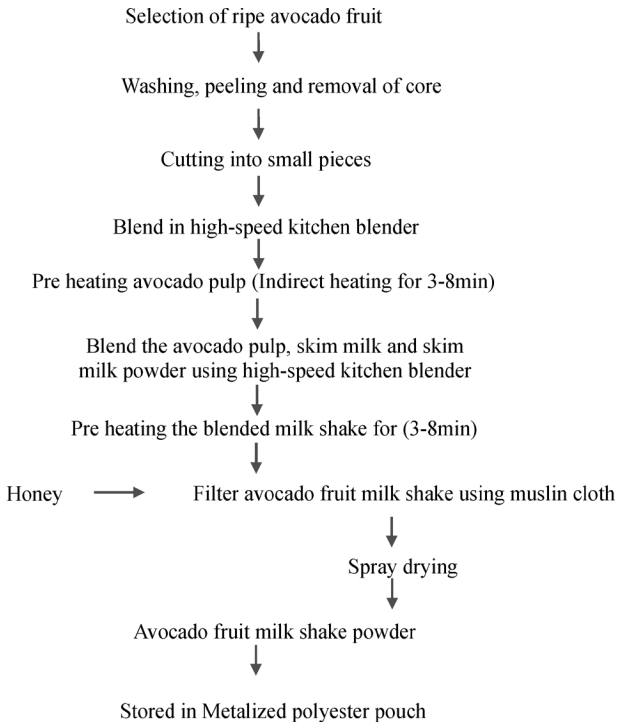

Fig. 1: Flow chart for the preparation of Avocado fruit milk shake powder

3. RESULT AND DISSCUSION

Table 1: Physico-chemical properties raw avocado pulp and optimized spray dried avocado milk shake powder

Physico- chemical properties		*Raw avocado pulp*	*Avocado milk shake powder*
Bulk density (g/cc)		0.712	0.371
Water activity		0.701	0.200
Color	L^*	49.35	93.11
	a^*	-3.42	-0.501
	b^*	34.95	11.35
Moisture content (%)		72.50	4.32
Protein (%)		2.00	24.30
Total carbohydrate (%)		1.85	62.59
Fat (%)		15.31	1.20
Ash (%)		1.54	6.20
Crude Fibre (%)		6.80	1.39
pH		6.35	6.32

Bulk density

The average bulk density value of raw avocado pulp and spray dried avocado milk shake powder was found to be 0.712 g/cc to 0.371 g/cc as shown in (Table 1). Compared to raw pulp the spray dried avocado milk shake powder found to be less due to evaporation of moisture and the high drying rate obtained at higher drying temperatures produces a higher ratio of surface to volume for the spray dried capsules, thus causing lower bulk density of the powders Karaaslan *et al*. (2014). Similar results obtained by (Pandey *et* al., 2020) where the untapped density known as bulk density were found to be 0.492 g/cc freeze dried Avocado fruit milk shake powder. Similar result that to be found (Dantas *et al.* 2018) For bulk density, values is 0.377 g/cm^3 in spray dried avocado powder drink with maltodextrin.

Moisture and Water activity

The average value of moisture in spray dried avocado milk shake powder and raw avocado pulp were 4.32 and 72.50 %, respectively and the average value of water activity in spray dried

avocado milk shake powder and raw avocado pulp were 0.701 and 0.200, respectively as shown in (Table 1). The decreased in moisture content and water activity in spray dried avocado milk powder might be due to exposure of sample to the higher driving force of heat in the spray dryer. Similar results are obtained Pandey *et al*. (2020) reported that the moisture content of the powder immediately after drying was found to be 2.9 per cent of spray-dried butter fruit milk shake with maltodextrin . And also, Vennila *et al*. (2020) reported that the moisture content in musk melon powder obtained by spray dried was found to be 4.2 per cent.

Color

The average color values of the avocado pulp was found to be 49.35 (L^*), -3.42 (a^*) and 34.95 (b^*) While compared to spray dried avocado milk shake powder were 93.11 (L^*), -0.501 (a^*) and 11.35 (b^*) this results are in line with the views of (Abilasha *et al*., 2008) and color value varied in spray dried powder mighty be due to incorporation milk and caramelization of honey in the drying process.

pH

The average value of pH in spray dried avocado milk shake powder and raw avocado pulp were 6.2 and 6.32, respectively shown in (Table 1) the pH powder varied might be due to addition of skim milk powder. Similar results were obtained (Pandey *et al*., 2020) analyzed the pH of spray dried butter fruit milk shake powder added with Maltodextrin had pH of 6.71 and classified as acid food.

Proximate composition

The average value of moisture, protein, fat, fibre, ash and carbohydrate in spray dried avocado milk shake powder and raw avocado pulp were 4.32, 24.3, 1.20, 1.39, 6.20 , 62.59 % and 72.50, 2, 15.31, 6.8, 1.54, 1.85 %, respectively shown in (Table 1). While comparing raw pulp and spray dried powder the powder obtained higher value in proximate composition and the in-moisture content and water activity in spray dried avocado milk powder might be due to exposure of sample to the higher driving force of heat in the spray dryer and increased in the protein, ash and total carbohydrate in spray dried avocado milk shake powder might be due to incorporation of skim milk powder and skim milk. Whereas, decreased in fat and fibre in spar dried avocado milk shake powder might be due to incorporation (SNF) skim milk in sample product.

Similar results are obtained Pandey *et al*. (2020) reported that the protein content was found to be 17.2 per cent of spray-dried butter fruit milk shake with maltodextrin . Priyanka *et al*. (2018), reported that the fat content was found to be 0.46 per cent of spray-dried mango milk powder. Bora *et al.* (2001), who reported that the avocado fruit had ash content of 1.6 ± 0.09 per cent. The carbohydrates content of 96.27 ± 0.31 per cent reported by Priyanka, (2018) in instant mango milk shake powder in freeze dried. Pandey *et al*. (2020) reported that the crude fiber content was found to be 0.84 per cent of spray-dried butter fruit milk shake with maltodextrin.

Storage Studies of optimized spray dried Avocado milk shake powder

Table 2: Effect of storage days on moisture content, water activity, bulk density and pH of Spray dried Avocado milk shake powder product

Packaging material	*Storage period*	*Moisture content*	*Water activity*	*Bulk density*	*pH*
Metalized polyester	0	4.32	0.221	0.371	6.32
	15	4.52	0.251	0.387	6.21
	30	4.83	0.280	0.398	6.18
	45	4.92	0.309	0.421	6.11
	60	5.11	0.317	0.435	6.07
	75	5.26	0.368	0.447	6.02
	90	5.37	0.390	0.465	6.01
	CD@5%	0.452	0.039	0.042	N/A
	SEm ±	0.148	0.013	0.014	0.190
CD: Critical Difference, SEm ±: Standard Error of mean					

For a three-month storage period the moisture content was initially 4.32 per cent. The moisture content steadily increased during the course of the storage period shown in Fig 2. At the end of the three-month storage period, it was shown to have grown from 4.32 to 5.37 per cent it is due to ingress of honey which cause the hygroscopic in nature which leads to increase the moisture

content over a time in packaged material and moisture revealed that the packaging material and storage time had a significant (P≤ 0.05) impact on the moisture content of spray dried avocado milk shake powder product. This values are consistent with the (vennila *et al.*, 2020).

The water activity were increased slightly due to ingress changes of chemical during storage values are shown above (Table 2) which varied from 0.221 to 0.390 shown as in Fig 3. Similar results obtained by progressive increase in the water activity of instant mango milk shake powder ranging from 0.241on 0th day to 0.330 on 90th day (Singham *et al.* 2014).

For a three-month storage period the bulk density was initially 0.371 g/cc. The bulk density steadily increased during the course of the storage period as shown in Fig 4. At the end of the three-month storage period, it was shown from 0.435 to 0.465. bulk density revealed that the packaging material and storage time had a significant (P≤ 0.05) impact on the bulk density of Spray dried Avocado milk shake powder product. Similar results obtained by Priyanka (2018) were observed Bulk density of mango milk powder increased with the storage period while initially it was observed that 0.71 then gradually increased during storage Moist powder exhibited higher angle of repose (mainly due to cohesion), despite the fact that the angle of internal friction usually decreases with increase in moisture level.

After every 15 days of storage for a three-month period, the pH of spray-dried avocado milkshake powder samples packaged in metalized polyester packing film was evaluated as shown in Fig 5. For a three-month storage period the water activity was initially 6.32. The pH steadily decreased during the course of the storage period. At the end of the three-month storage period, it was shown from 6.32 to 6.01. pH revealed that the packaging material and storage time had a significant (P≤ 0.05) impact on the pH of Spray dried Avocado milk shake powder product. Similar results obtained by Priyanka (2018) there was progressive slightly decrease in the pH of instant mango shake powder by spray dried ranging from 6.08 on 0th day to 5.70 on 90th day

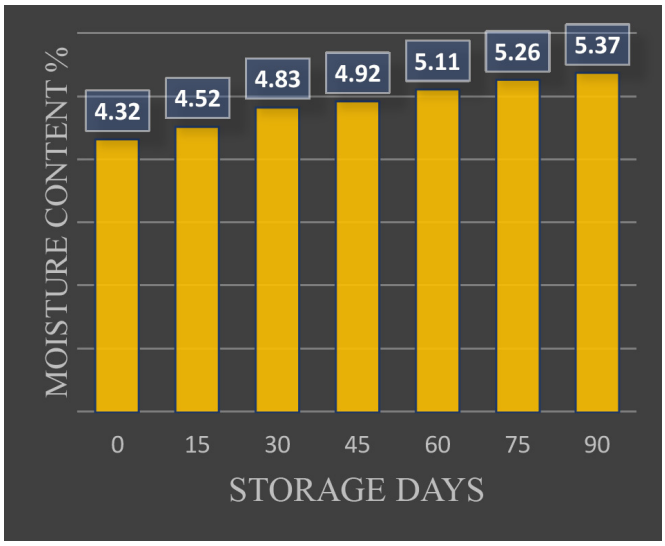

Fig. 2: Effect of moisture content on storage days

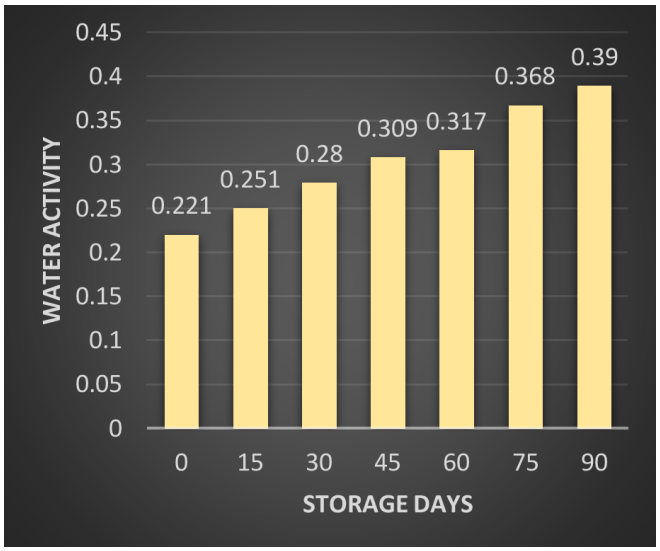

Fig. 3: Effect of water activity on storage days

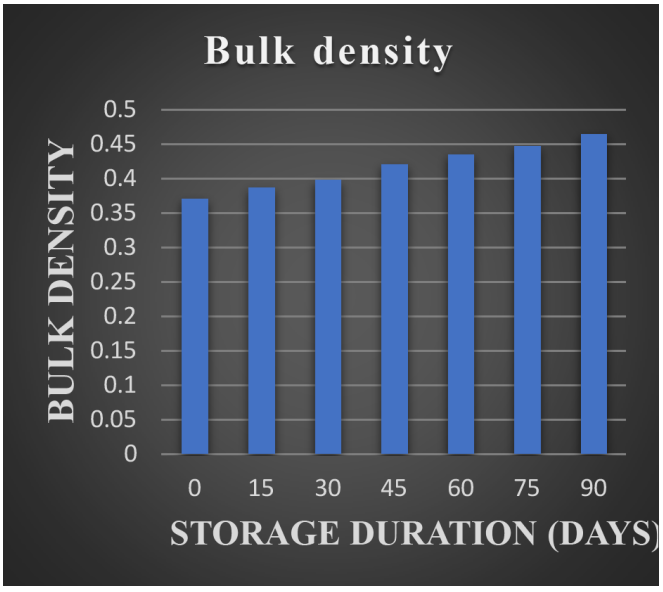

Fig. 4: Effect of on bulk density storage days

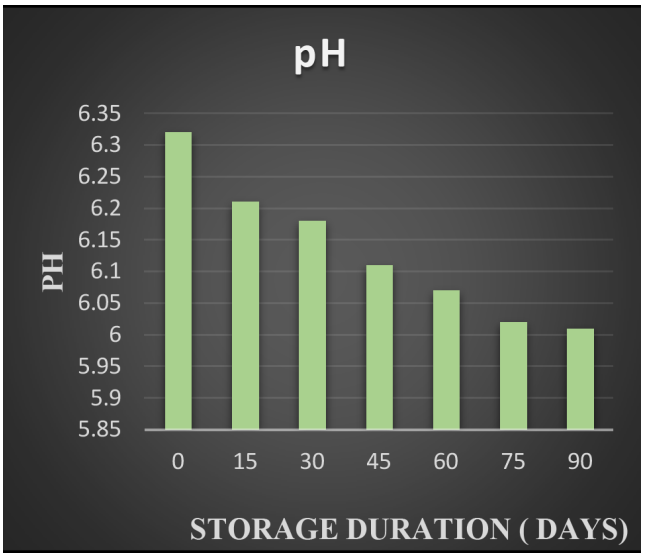

Fig. 5: Effect of on pH storage days

Effect of packaging material and storage days on sensory characteristics

The sensory acceptability of the Avocado milk shake powder were assessed on each withdrawal for 15 days interval and recorded in terms of color, appearance, consistency, flavour, mouth feel and overall acceptability three months storage period.

Effect of storage on sensory scores of avocado milk shake powder stored in metalized polyester (mp) film

The sensory scores for the optimized Avocado milk shake powder product were stored in metalized polyester packaging cover are presented in Table 3. It was observed that, with increasing storage period, mean sensory sores for overall acceptability of the Avocado milk shake powder declined from 8.02 to 6.44 at the end of the storage period, the sensory scores for color, appearance, consistency, flavour, mouth feel and overall acceptability of Avocado milk shake powder product were rated as 8.03, 8.8, 7.5,7.4, 8.01 and 8.02, respectively. The highest average overall acceptability was observed at 0, 1 and 2 months of storage indicated that Avocado milk shake powder were acceptable up to two months of storage. Decreasing trends ($p < .05$) were observed for all the sensory attributes like, color, appearance, consistency, flavour, mouth feel and overall acceptability of products during storage.

Effect of packaging material and storage days on microbial load

The microbiological analysis was carried for the Avocado milk shake powder packed in metalized polyester packaging film using Total plate count (TPC) method.

Effect of microbial load on avocado milk shake powder during storage days

Microbial load was calculated in terms of cfu/g and presented in Table 4. During the storage period of three months yeast and molds were detected and *Coliforms* were found to be absent. Bacterial count were found to increase in the range of 0.12 to 3.1 X 10^4 cfu/g. Yeast and mold were not detected up to first month of storage period. From the 75th day of storage, yeast and molds were detected in the range of 1.2 X 10^0 to 2.3 X 10^0 cfu/g. It was clear that, bacterial count and fungal count increased during storage days.

The TPC load of Avocado milk shake powder the kept in metalized polyester pouches at ambient storage conditions increased significantly ($p \leq .05$) from 0.12 to 3.1 X 10^4 cfu/g. This higher bacterial count could be due to the adverse conditions of storage environment (temperature and relative humidity), which facilities the rapid entry of moisture inside the Avocado milk shake powder sample and subsequently enhances the bacterial count of the product.

(Barooah *et al.,* 2018) Similar to the results of the bacterial count, the fungal count of the banana milk shake powder samples also increased significantly from third month of the storage period. 0 days of preparation at an interval of 30 days the findings of the study revealed significant increase in the microbial load in banana milk shake powder from 30 days of storage at 5% probability level up to 90 days. At 0 days the cfu count depicted non-significant increase in the packaging materials. At 30 days, microbial load was found to increase significantly ($F=4.7931$) from 0 to 0.40×10^{-6} cfu/ mL.

(Priyanka *et al.,* 2018) reported in Mango milkshake powder no visible microbial growth was seen till 30th day of storage followed by an increasing trend in the microbial growth from 60th to 90th day of storage. Maximum microbial growth noticed was 3.45±.06 log10 cfu/mL which was well within permissible limits as given by FSSAI (2011).

Table 3: Effect of packaging material and storage days on sensory characteristics of spray dried avocado milk shake powder

Packaging material	*Storage days*	***Color***	***Appearance***	***Consistency***	***Flavour***	***Mouth feel***	***OA***
Metalized polyester film	0	8.02	8.55	7.68	7.45	7.51	8.02
	15	7.90	8.10	7.30	7.2	7.30	7.70
	30	7.70	7.70	7.10	7.00	7.40	7.68
	45	7.50	7.50	7.00	6.70	7.10	7.01
	60	7.00	7.10	6.80	6.40	6.90	7.00
	75	6.80	6.90	6.60	6.80	6.50	6.56
	90	6.70	6.60	6.20	6.20	6.40	6.44
	CD @ 5%	0.895	0.912	0.821	0.862	0.876	0.947
	Sem ±	0.294	0.315	0.264	0.213	0.281	0.304

Table 4: Effect of storage on microbial load of spray dried avocado milk shake powder sample stored in metalized polyester (MP) film

Storage period (days)	*Total plate count (10^4 CFU/g)*	*Yeast and molds (10^0 CFU/g)*	*Coliforms (10^0CFU/g)*
0	0.12	Nil	Nil
15	0.14	Nil	Nil
30	0.21	Nil	Nil
45	0.25	Nil	Nil
60	0.29	Nil	Nil
75	2.9	1.2	Nil
90	1.3	2.3	Nil
SEm (±)	0.155	0.238	**-**
CD @ 5 %	0.056	0.058	-

CONCLUSION

Developed avocado milkshake power is healthy alternatives, storage able, and reasonable. Comparing to raw pulp and spray dried avocado milk shake powder of proximate composition and physical parameter were analyzed and concluded that the spray dried powder have higher amount of protein, fat, ash, and crude fibre in milk increased after avocado pulp was added, but its low moisture content and water activity indicated that it has a longer shelf life with a low wettability time and is instantaneously soluble in water. During storage 0f 90 days results shows progressively acceptable and sensory and microbial analysis were analyzed Further research is needed for can be tried with different flavors and various value-added food products can be made by incorporating avocado milk shake powder like in chocolate, milk bar.

References

ABHILASHA, K.R., 2018, Optimization of Process Parameters of Spray Drying for Production of Pineapple Juice Powder (Doctoral dissertation, University of Agricultural Sciences, GKVK.).

AHMED, E. M.; BARMORE, C. R. AVOCADO. IN: NAGY, S.; SHAW, P. E.; WARDOWSKI, W. F. 19900, (Ed.). Fruits of tropical and subtropical origin: composition, properties and uses. Lake Alfred: AVI Publishing.

ANANDHARAMAKRISHNAN, C., RIELLY, C.D. AND STAPLEY, A.G.F., 2007, Effects of process variables on the denaturation of whey proteins during spray drying. *Dry. Technol.*, **25** (5):799-87.

AOAC, 2000, Official Methods of Analysis, 18th edn, Association of Official Analytical Chemists, Gaithersburg, MD, USA

ARAB, A. A., SALEM, A. F. M. AND ARAB, E. A., 2011, Physico-chemical properties of atural pigments (*anthocyanin*) extracted from Roselle calyces (*Hibiscus subdariffa*). *J. Am. Sci.*, **7** (7):445-456.

BAROOAH, N., DAS, P., BAROOAH, M.S., SETH, D.K. AND DUTTA, P., 2018, Storage studies on spray

dried ripe banana powder produced by response surface methodology. *Int. J. Curr. Microbiol. Appl. Sci.*, **7**:1922-33.

BATISTA, C. A., CEREZAL, M, P., AND FUNGLAY, V., 1993, E.L. AGUACATE (*Persea americana*) Nutritional Composition of Avocado Pear : 63-69

BHUYAN DJ, ALSHERBINY MA, PERERA S, LOW M, BASU A, DEVI OA, BAROOAH MS, LI CG, PAPOUTSIS K., 2019, The odyssey of bioactive compounds in avocado (*Persea americana*) and their health benefits. *Antioxidants* **8**:426.

BORA, P.S., NARAIN, N., ROCHA, R.V. AND PAULO, M.Q., 2001, Characterization of the oils from the pulp and seeds of avocado (cultivar: Fuerte) fruits. *Grasas y aceites*, **52** (3-4): 171-174.

CANTO, W.D., SANTOS, L.D. AND TRAVAGLINI, M.M.E., 1980, Óleo de abacate: extração, usos e seus mercados atuais no Brasil e na Europa. Campinas. *ITAL*:143.

CAPARINO, O. A., TANG, J., NINDO, C. I., SABLANI, S. S., POWERS, J. R. AND FELLMAN, J. K., 2012, Effect of drying methods on the physical properties and microstructures of mango (*Philippine Carabao* var.) powder. *J. Food Eng.*, **111** (1): 135-148.

DANTAS, D., PASQUALI, M.A., CAVALCANTI-MATA, M., DUARTE, M.E. AND LISBOA, H.M., 2018, Influence of spray drying conditions on the properties of avocado powder drink. *Food chemistry.*, **266:** 284-291.

FAVIER, J.C., IRELAND-RIPERT, J., TOQUE, C., FEINBERG, M. AND FAVANO, A., 1999, Repertório geral dos alimentos: tabela de composição. In Repertório geral dos alimentos: tabela de composição: 895-895.

FSSAI, 2011, Food Safety and Standards (Food Product Standards and Food Additives) regulation (Part II), food safety and standards authority of India. 496-503.

FSSAI, 2012, Manual of methods of analysis of foods, microbiological testing. 94-96. http://old.fssai.gov.in/Portals/0/Pdf/15Manuals/microbiology%20manual.

KARAASLAN, İ. AND DALGIÇ, A.C., 2014, Spray drying of liquorice (Glycyrrhiza glabra) extract. *J. Food Sci. Technol.*, **51**(11): 3014-3025.

LEBRUN, P., KRIER, F., MANTANUS, J., GROHGANZ, H., YANG, M., ROZET, E., BOULANGER, B., EVRARD, B., RANTANEN, J. AND HUBERT, P., 2012, Design space approach in the optimization of the spray-drying process. *Eur. J.Pharm. Biopharm.*, **80**(1): 226-234.

NICOLI, M. C., 2012, Shelf - life assessment of food. New York, NY: CRC Press.

NNAEDOZIE, C.C., SANDERS, C., MONTES, E.C., FORNY, L., NIEDERREITER, G., PALZER, S. AND SALMAN, A.D., 2019. Investigation of rehydration of food powder mixtures. Powder Technology, 353, pp.311-319.

ORHEVBA, B.A. AND JINADU, A.O., 2011, Determination of physico-chemical properties and nutritional contents of avocado pear (*Persea americana* M.). Proc. 11th Intl. Conf., *Nigerian Institution of Agricultural Engineers* (NIAE).

PANDEY, S., APARNA, K., CHAUHAN, A.K. AND SINGH, M., 2020, Development of phytonutrient enriched avocado milkshake powder and its quality evaluation. *Indian J Dairy Sci.*, **73** (6) : 1-7.

PHISUT, N., 2012, Spray drying technique of fruit juice powder: some factors influencing the properties of product. Int. Food Res. J., 19(4): 1297-1306

PRIYANKA 2018., Development of Processing Technology for Instant Mango Shake Powder *Food Sci. Technol*, CCSHAU, Hisar., 2018.

REBOLLO, A. J. G., 1998, Effects of comsumption of meat product rich in monounsaturated fatty acids (the ham from the Iberian pig) on plasma lipids. *Nutrition Research*, 18.

SADASIVAM, S. AND MANICKAM, A., 1992, Biochemical methods for agricultural sciences. Wiley eastern limited.

SINGHAM P, GENITHA I, KUMAR R., 2014, Comparative study of ripe and unripe banana flour during storage. J Food Proc Technol **5**(11):1–6

TANGO, J. S. T.; CARVALHO, C. R. L.; SOARES, N. B., 2004, Physical and chemical characterization of avocado fruits aiming its potencial for oil extraction. *Revista Brasileira de Fruticultura,* **26** (1).

TIAN, H. X., ZHANG, Y. J., CHEN, C., QIN, L., XIAO, L. Z., MA, H. R., & YU, H. Y. (2019). Effects of natural ingredients on the shelf life of chicken seasoning. Food Chemistry, 293, 120–126.

USDA AND HHS. 2011, Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans (Part B. Section 2: The Total Diet. B2:11). U.S. Department of Agriculture and U.S. Department of Health and Human Services. Washington, DC.

VENNILA, P., KENNEDY, Z.J., PREETHA, P. AND PANDIDURAI, G., 2020, Studies on formulation and evaluation of muskmelon fruit powder incorporated ready-to-use products. *Journal of Pharmacognosy and Phytochemistry.*, **9**(3): 1768-1771.