



Health mix incorporated with Coconut flour

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Abstract

Health mix was prepared by varying the proportions of coconut flour and the most acceptable product was selected after organoleptic evaluation. Quality characteristics, nutrient composition and shelf life of the health mixes were determined and compared with the standard. BV3 containing 30% coconut flour had obtained maximum scores for all the sensory attributes like texture, taste and overall acceptability and was selected to evaluate the shelf life. The mean overall acceptability scores were 8.3 ± 0.45 and 8.6 ± 0.48 on 0th day and 3.8 ± 0.74 and 4.1 ± 0.53 on the 90th day for standard and BV3 respectively. The product was desirable up to 90 days of storage. The number of microbial colonies was within the permissible range. The energy, carbohydrate, protein and fat content of BV3 were lower than the standard, however the fibre content (14.88g) was much greater.

Introduction

Coconut dietary fiber is particularly important as it is reported to produce high amount of butyric acid in stomach, which helps in inhibiting tumor formation.

Coconut flour incorporated foods show low glycemic index, which is good for proper control and management of diabetes mellitus and in the maintenance of weight. It can reduce serum total cholesterol, LDL cholesterol and triglycerides in moderately raised serum cholesterol levels of human (Trinidad, 2001). Coconut flour plays a role in controlling cholesterol and sugar levels in blood and prevention of colon cancer. Studies revealed that consumption of high fiber coconut flour increases faecal bulk (Arancon, 2009).

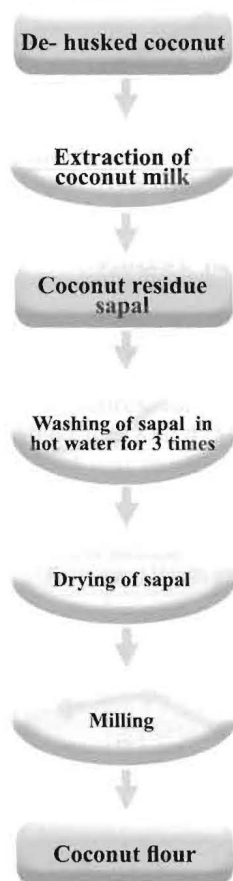
In the present study, health mixes were prepared by varying the proportions of coconut flour, from which the most acceptable product was selected after organoleptic evaluation for shelf life studies. This value addition will improve the health of the consumer as indigenous food products are used for the formulation.

Materials and methods

Ethical Clearance

Ethical clearance was obtained for Human studies from PSG Institute of Medical Sciences and Research, Coimbatore.

Fig.1 Preparation of Coconut Flour



Ingredients for Health Mix

Ingredients namely millets like Ragi, Bajra and Jowar, pulses like roasted Bengal gram and sprouted green gram, nuts and oil seeds like peanuts, almonds and cashew nuts were selected. Sugar and cardamom were selected for flavor and taste. The procured samples were cleaned, sun dried, roasted and finally ground in a mill.

Preparation of Coconut Flour

Coconut flour was prepared from coconut residue called sapal which is the meal usually discarded after milk extraction (Trinidad, 2002). The preparation of coconut flour is explained in figure-1. The flour obtained was stored at room temperature and used for product formulation.

The ingredients (Table-1) were mixed together and packed in HDPE packages, sealed, labeled and stored at room temperature.

Preparation of Porridge

Porridge was prepared by dissolving 50 g formulated health mixes with 150 ml boiling water and cooked for five minutes in a low flame and served warm. Sugar was added for taste.

Organoleptic Evaluation

Organoleptic evaluation is an important part of the process of developing new food products. It provides information pertaining to improving the quality of a food product and it is essential to assure the maintenance of high quality standard on a continuing basis. An organoleptic change includes the change in color, flavor, taste and consistency.

Organoleptic characteristics of the porridge were evaluated by 20 panel members for different sensory attributes like color, taste, texture, flavor and overall acceptability using nine point hedonic scale to select the most acceptable variant. The panel members were selected on the basis of their health, cooperation, willingness, availability and knowledge of sensory analysis as also ability to discriminate the various criteria for sensory evaluation.

Nutrient Calculation

Nutrients namely Carbohydrate, Protein, Fat, Fiber and Energy were calculated using Nutritive values for Indian foods (ICMR, 2012).

Shelf Life Study of the Formulated Health Mixes

Contamination of foods by mold or bacteria is common, hence their presence in the finished product is considered unfit for consumption (Ranganna, 1986). Shelf life can be defined as a finite length of time after production and packaging during which the food product retains a required level of quality under well-defined storage conditions. This required quality level allows the product to be acceptable for consumption (Maria, 2012).

The formulated health mixes were packed in HDPE packages and stored at room temperature for three months. The samples were drawn at regular intervals of seven days and 15 days for microbial analysis and organoleptic evaluation respectively to find out the shelf life of the products.

Microbial Analysis of the Formulated Products (FSSAI Standards, 2012)

The formulated food products were subjected to microbial analysis every seven days and the food homogenate was prepared by dissolving 1g of powdered sample mixed with distilled water and was mixed vigorously. From this, the sample dilutions were prepared. For each dilution a fresh pipette was used. Pipetted 1 ml of food homogenate into tube containing 9 ml of distilled water, from the first dilution transferred 1 ml to second tube and so on till seventh dilution.

About 0.1 ml of 5th and 6th dilution was plated on sterile nutrient agar plates. The plates were incubated

Table-1 Formulation of Health Mixes

Ingredients	Quantity (g / 100g)					
	Standard	BV1	BV2	BV3	BV4	BV5
Coconut flour	-	10	20	30	40	50
Ragi	20	20	20	15	10	10
Bajra	20	20	20	15	10	10
Jowar	20	20	20	15	10	10
Roasted Bengal Gram	15	10	5	7.5	10	5
Sprouted Green gram	15	10	5	7.5	10	5
Peanuts	5	5	5	5	5	5
Almond	2.5	2.5	2.5	2.5	2.5	2.5
Cashew nut	2.5	2.5	2.5	2.5	2.5	2.5
Cardamom	1	1	1	1	1	1

BV1, BV2, BV3, BV4, BV5 - Variants

at 37°C for 24 h in inverted position. Following the incubation, all the colonies present on the plates were counted. Total number of colonies present in 1 g of the sample was calculated using the formula

$$N = \frac{(\sum c)}{(N1 + 0.1N2)D}$$

$\sum c$ is the sum of colonies counted on all the dishes retained
 N1 is the number of dishes retained in the first dilution
 N2 is the number of dishes retained in the second dilution
 D is the dilution factor corresponding to first dilution

The colonies were counted and tabulated, from which the shelf life of the products was estimated.

Organoleptic Evaluation

Organoleptic characteristics were measured every 15th day till 90 days of storage as mentioned earlier.

Statistical Analysis

The obtained results were interpreted using statistical tools. Tools such as general linear model, t- test, ANOVA and post hoc were performed.

Results and Discussion

Nutrient Content of Health Mixes

Functional properties are physicochemical properties which give information on how a particular ingredient (protein and carbohydrate) will have on a food system (Neelam, 2005). Nutrients namely carbohydrate, protein, fat, fibre and energy of the prepared health mixes were calculated (NIN, ICMR). The energy, carbohydrate, protein and fat content of the prepared health mix (Table II) were lower than the standard, however the fibre content (14.88g) of BV3 was much greater. This is because BV3 was prepared with coconut flour. According to Trinidad et al. (2006), coconut flour contains 600g of total fiber/kg with 560g of insoluble and 40 g of soluble fiber/kg. The glycemic index of coconut flour supplemented foods decreases with increasing levels of dietary fiber from coconut flour. Therefore this health mix can be recommended for diabetics.

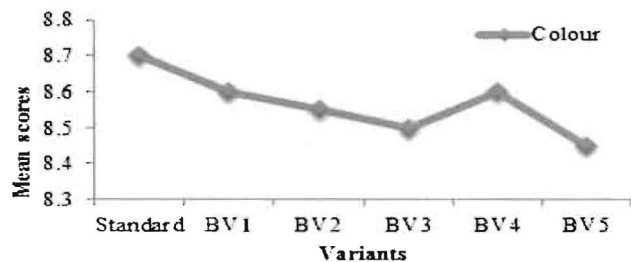


Fig.2 Mean Scores for Colour

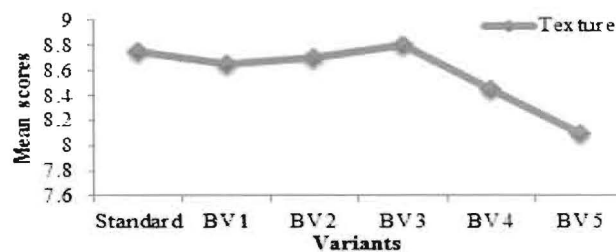


Fig.3 Mean Scores for Texture

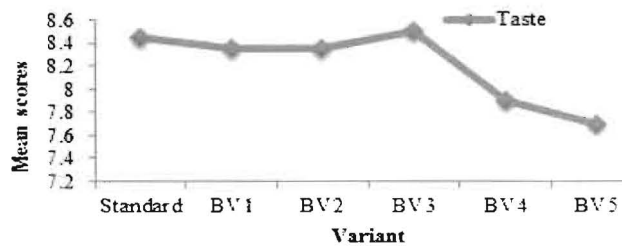


Fig.4 Mean Scores for Taste

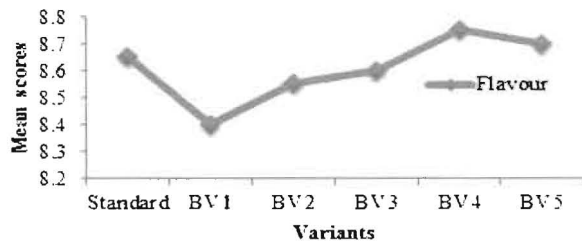


Fig.5 Mean Scores for Flavour

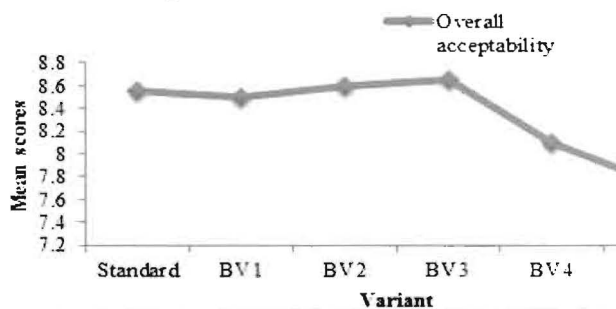


Fig.6 Mean Scores for overall

Health Mix	Nutrients/100g				
	Energy (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Fiber (g)
Standard	378.0	65.0	17.0	3.0	6.0
BV3	343.21	60.77	16.91	9.69	14.88

Organoleptic Evaluation Scores of Health Mix Prepared using Coconut Flour

The mean scores of organoleptic evaluation for porridge prepared with health mix and standard are shown in Figures 2, 3, 4, 5 and 6.

It is observed (Fig 2) that the standard had obtained maximum score for colour (8.7±0.45) followed by BV4 (8.6±0.48). Mean colour score of variants ranged between 8.4 ±0.66 and 8.6±0.48. The colour was off white for standard, but for the variants it was very light brown, light brown, yellow, brown and dark brown, corresponding to the increasing order of addition of coconut flour. Although the colour was darker in the variants they had a good eye appeal.

The scores for texture of porridge ranged from 8.1±0.62 to 8.8±0.4. Most of the panel members opined that BV4 was moderately acceptable and BV5 was not acceptable. The high fiber content of coconut flour has

interfered with the textural properties of porridge. The characteristic smoothness was not observed in BV4 and BV5 which had 40 and 50% coconut flour incorporation. The results reveal that the mean score obtained for texture of BV3 was the maximum (8.8±0.4).

Same scores (Fig. 4) were obtained for taste by BV1 and BV2. The mean score for standard was 8.4±0.66 while BV3 had obtained maximum score (8.5±0.59) for taste which was greater than standard porridge. The

Days	Number of CFU/gm
0	> 1 CFU/ gm
7	> 1 CFU/ gm
14	> 1 CFU/ gm
21	6 CFU/ gm
28	1 ×10 ² CFU/gm
35	1.8×10 ² CFU/gm
42	0.4×10 ³ CFU/gm
49	2.2×10 ³ CFU/gm
56	4.9×10 ³ CFU/gm
63	6.8×10 ³ CFU/gm
70	8.2×10 ³ CFU/gm
77	1.1×10 ⁴ CFU/gm
84	1.4×10 ⁴ CFU/gm
91	1.7×10 ⁴ CFU/gm

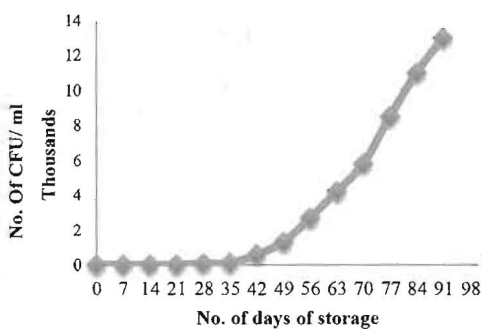


Figure.7 Number of colonies / g of sample on storage intervals

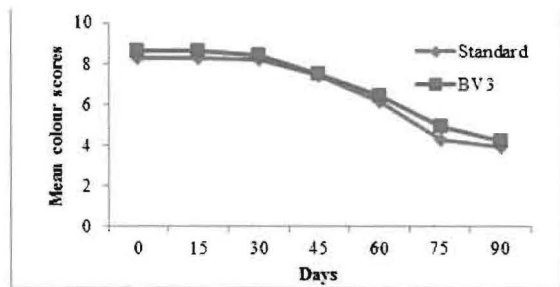


Fig.8 Mean Scores for Colour of Standard and BV3

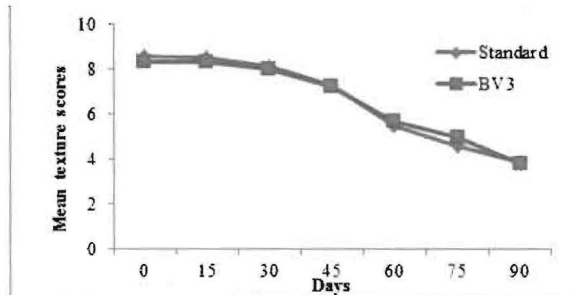


Fig.9 Mean Scores for Texture of Standard and BV3

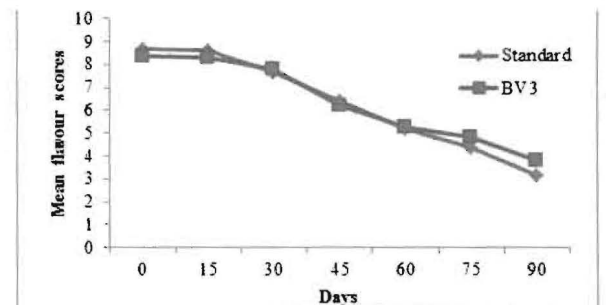
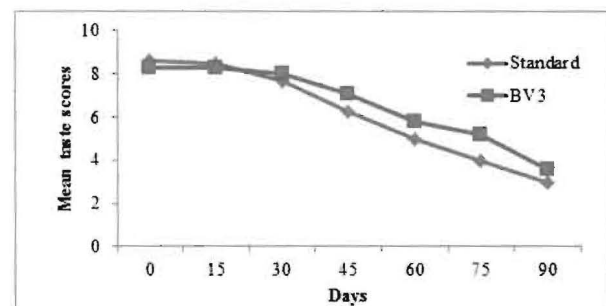
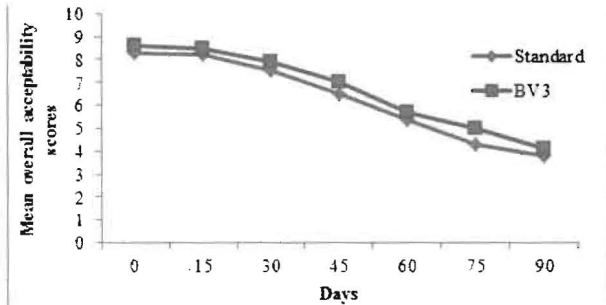


Fig.11 Mean Scores for Flavour of Standard and BV3



mean scores for taste decreased as the quantity of coconut flour increased. This is because coconut flour is rich in fiber and has an insipid taste thus necessitating extra amount of sugar to be added.

The mean scores (Fig.5) obtained for flavor of the porridge increased with each successive increase in incorporation of the coconut flour. BV4 had a strong coconut flavor and had obtained the maximum score (8.7 ± 0.43). The mean flavor scores of variants ranged between 8.4 ± 0.48 and 8.7 ± 0.43 as against 8.65 ± 0.47 for standard porridge.

From Fig. 6 it is seen that the overall acceptability of BV3 was the maximum. BV1 and BV2 were evaluated as acceptable and BV4 and BV5 were found to be mildly unacceptable. The mean overall acceptability score of porridge prepared with coconut flour ranged between 8.1 ± 0.53 and 8.6 ± 0.47 . The mean score obtained for overall acceptability of BV3 was found to be higher (8.6 ± 0.47) than standard (8.5 ± 0.58).

The results of one way ANOVA showed that there was a significant difference observed between groups for texture, taste and overall acceptability while it was not significant for colour and flavor.

BV3 containing 30% coconut flour had obtained maximum scores for all the sensory attributes like texture, taste and overall acceptability and was therefore selected to evaluate the shelf life and to determine the cost of the product.

Shelf Life Study of Standard and BV3

Shelf life is defined as the maximum time for which a food product can be stored under specific environmental conditions without any appreciable deterioration in quality and acceptability. Environmental factors affecting food stability include humidity, oxygen, toxic vapours, physical contamination, light and the time temperature history of the package (Khanna, 1982). Shelf life testing is a standard practice used to estimate the quality and stability of a given food during its storage. The formulated health mix and the standard were tested for microbial load every 7 days, and organoleptic evaluation was carried out at an interval of every 15 days up to 90th day of storage.

Microbial Load

The results of microbial load (Fig.7 and Table-III) revealed that the growth of microorganisms till 77th day was within the permissible limit according to BIS standards (IS 11536:2006), which was below 1.0×10^4 CFU / g. The results also depicted that till 21st day of storage there were very few visible colonies, which can be attributed to the proper packaging and handling. After the 21st day of storage, there was a steady increase in the microbial load up to 90 days, yet the number of colonies were within the permissible range. However, results of organoleptic evaluation indicated a decrease in



the scores Therefore the shelf life studies were carried out till 90 days of storage. Further storage of the mix increased the colony count making the product unfit for consumption.

Sensory Evaluation

The mean scores for colour (Fig 8,9,10,11,12) of the BV3 porridge was higher at the beginning of the shelf life study and upto 30th day. From 45th day the mean scores reduced to a greater extent and was 4.2 ± 0.4 on the 90th day. The scores had decreased by more than 50% on the 90th day in both standard and BV3. A significant difference in colour between standard and BV3 was observed on storage. Similar results were observed in the mean score for flavor.

On 0th day, the standard had obtained a slightly greater mean score (8.6 ± 0.48) for taste compared to BV3 (8.3 ± 0.64). The scores of BV3 were the same on the 0th and 15th day. Thereafter the scores steadily decreased and was 3.6 ± 0.8 on 90th day. Likewise the mean scores for standard also declined steadily and was as low as 3.0 ± 0.89 on the 90th day. The decline was sharp between 30th and 45th day in standard, and between 45th and 60th day, and 75th and 90th day in BV3, however the difference was not statistically significant.

Storage of the health mix containing coconut flour has affected the flavor of the products. The gradual decrease in the mean scores for flavor was observed from 15th day of storage and the score was least on the 90th day of storage. The decrease in scores was marginal up to 45th day and thereafter it started decreasing to a greater extent, and a sharp decline between 30th and 45th day, and between 45th and 60th day was observed. Statistical analysis showed a significant difference in flavor between standard and BV3 on storage.

The mean overall acceptability scores were 8.3 ± 0.45 and 8.6 ± 0.48 for standard and BV3 respectively on 0th day. Here again the scores reduced on storage in both, and it was 3.8 ± 0.74 and 4.1 ± 0.53 in standard and BV3 respectively. It is also clear that the scores had reduced by nearly two-thirds on the 90th day compared to 0th day in both standard and BV3, and the difference was statistically significant. The organoleptic scores of BV3 was acceptable and the panel members did not report any adverse comments about the health mix porridge even on the 90th day..

Cost Calculation

The cost of the standard is Rs.380/ kg whereas that of BV3 is Rs.500/ kg. This increase in cost of BV3 is because of the high production cost of coconut flour. However, from the stand point of health and nutrition, the formulated health mix is far ahead than the standard health mix due to its high fiber and low digestible carbohydrate content. Its application as a therapeutic food holds high value and the health mix can be marketed as a health food. Regular consumption of the formulated health mix prevents/ delays the onset of lifestyle diseases such as obesity, diabetes mellitus and cardio vascular diseases.

Conclusion

The developed health mix is a good source of fiber and low in digestible carbohydrate besides it is a gluten free flour. This helps to maintain the blood glucose level and can be recommended for diabetics. As the coconut is an indigenous food of our country and also has numerous health benefits it can replace cereals like oats (which are not grown in India) and recommended for therapeutic purposes. The coconut flour incorporated health mix can be promoted as a therapeutic alternative to the commercial ones which may not be from natural food source. Since it is also gluten free flour, it can be recommended for individuals with gluten allergy. The formulated health mix can be focused towards the niche market as it satisfies the specific needs of the particular section of people namely diabetics, cardio vascular disease patients and obese individuals. ■

References: Arancon, R. N., "Coconut flour", *Indian Coconut Journal*, Volume. 6(1), pp.1-8, 2009.

Trinidad, P. (2001). *Coconut Flour from Residue: A Good Source of Dietary Fibre*. *Indian Coconut Journal*, 9-13.

ICMR (2012). *Nutritive Value of Indian Foods*. National Institute of Nutrition, 47-58.

Ranganna, S. (1986). *Handbook of Analysis of Quality Control for Fruit and Vegetable Products*. New Delhi: Tata Mcgraw Hill Publ.Co.,

Chernoff, R. (2006). *Geriatric Nutrition: The Health Professional's Handbook*, 3rd Edn. . Massachusetts: Jones and Bartlett.

Maria C.Nicoli. (2012). *Oxidative stability and shelf life of foods containing oils and fats*, Academic Press, Elsevier, 133.

Morley Je, T. D. (2007). *Geriatric Nutrition*, 1st Edn. London: Crc Press.

Pruet Satusap, V. C. (2014). *Development of Cereal and Legume Based Food Products for the Elderly*. Springerplus , 451-459. Retrieved from Available Via <http://www.Who.Int/Nutrition/>.

Trinidad, P.T., Mallillin, A.C., Valdez, D.H., Loyola, A.S., Castillo, J.C., Encabo, R.R., Masa, D.B., Maglaya, A.S. and Chua, M.T., (2002) "Dietary fiber from coconut flour", *A functional food*. *Innovative Food Science and Emerging Technologies*, 7: 309-317.

Neelam, K. (2005). *Bakery Science and Cereal Technology*.

Kerala leads in coconut farming and production

As per the latest statistics on coconut published by the Ministry of Agriculture & Farmers Welfare, Government of India, the state of Kerala leads in coconut farming and production. Chhattisgarh is the leading state in coconut productivity with 16508 nuts per ha. Andhra Pradesh, Gujarat, Tamilnadu and West Bengal are other states which follow Chhattisgarh in coconut productivity. Kerala is producing 7429.39 million nuts annually. Tamilnadu, Karnataka and Andhra Pradesh are the other states that follow Kerala in coconut production.

Area and production of coconut

STATE	Area "000"Ha	% Share	Production Million nuts	% Share	Productivity (Nuts/Ha)
Kerala	770.62	36.90	7429.39	33.51	9641
Tamil Nadu	459.74	22.01	6171.06	27.84	13423
Karnataka	526.38	25.20	5128.84	23.14	9744
Andhra Pradesh	103.95	4.98	1427.46	6.44	13732
West Bengal	29.51	1.41	373.58	1.69	12658
Odisha	50.91	2.44	328.38	1.48	6451
Gujarat	22.81	1.09	312.68	1.41	13706
Maharashtra	27.75	1.33	271.24	1.22	9775
Bihar	14.90	0.71	141.38	0.64	9489
Assam	19.73	0.94	132.59	0.60	6720
Chhattisgarh	1.85	0.09	30.54	0.14	16508
Tripura	7.20	0.34	29.51	0.13	4097
Nagaland	0.33	0.02	2.67	0.01	8091
Others	52.80	2.53	388.13	1.75	7351
All India	2088.47	100.00	22167.45	100.00	10614

Source: Horticulture Division, Department of Agriculture, Co-operation & farmers Welfare, Government of India.