ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 7(G), pp. 28235-28238, July, 2018

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

WHEY PROTEIN CONCENTRATE (WPC) – A NUTRACEUTICAL INGREDIENT IN THE FORMULATION OF FINGER MILLET BASED READY- TO- EAT (RTE) FOOD

Harini Venugopal*., H.M. Jayaprakasha and Arun Kumar. H

Dairy Science College, KVAFS University, Hebbal, Bengaluru-560024, India

DOI: http://dx.doi.org/10.24327/ijrsr.2018.0907.2421

ARTICLE INFO

Article History:

Received 10th April, 2018
Received in revised form 2nd May, 2018
Accepted 26th June, 2018
Published online 28th July, 2018

Key Words:

Whey protein concentrate, finger millet, crude fibre, fat, minerals and functional properties

ABSTRACT

There has been a consistent effort to increase functionality of cereals-based foods by supplementing them with higher protein, phenolics, dietary fibre and mineral content so to qualify them as functional foods. The proposed research article emphasises on utilization of underutilized millets besides utilizing excellent nutraceutical ingredient WPC which has been conserved from one of the largest by-product of dairy industry. The results reveal that enrichment of WPC to RTE food has high impact on functional and nutritional properties of RTE food. In this context an attempt was made to expose the effect of WPC on finger millet based RTE foods. WPC was incorporated at the levels of 4, 6, 8 and 10 per cent. Among these levels 10 per cent level (WPC) was found to possess significantly (p= .05) higher protein (17.17 %) than control (12.25 %) and lower carbohydrate content (68.20 %) when compared to control (74.63 %). Among functional properties water holding capacity and oil holding capacity was found to have significant effect. These properties make remarkable favourable conditions for the development of new generation product which sounds high in nutritional quality and adds desired functionality to RTE foods.

INTRODUCTION

New product development and continuous innovation in food industry has been partially a reflection of the changing needs of consumer for health, nutrition and convenience. The nutritional status of a community has therefore been recognized as an important indicator of national development. For solving the problem of deep rooted food insecurity and malnutrition, nutritional quality should be taken into consideration.

Whey proteins provide good functional and nutritional properties for formulation of novel products which have potential to improve the quality of food products. Most of the key functional properties of WPC may be classified into two main groups: hydration related and surface related. Hydration related functional properties include dispersibility, solubility, swelling, viscosity and gelation. Surface related properties include emulsification, foaming, and absorption at air water interfaces.WPC also have high content of Sulphur containing amino acids which supports antioxidant functions and can be exploited in many food formulations which exhibits multi-dimensional functionality (Jayaprakasha and Bruecker, 1999; Alok and Kanawajia, 2010).

Whereas, Minor Millets, comprising the small-seeded group of the Poaceae family, represent one of the major food- and feed-crops in the semi-arid tropical regions of Africa and Asia. Millets in general contain 60-70% carbohydrates, 7-11% proteins, 1.5-5% fat, and 2-7% crude fiber and are also rich in vitamins and minerals .A minor millet crop includes Finger millet, (*Eleusine coracana*), Pearl millet (*Pennisetum glaucum*), Foxtail millet (*Setaria italica*), Kodo millet (*Paspalum setaceum*), Little millet (*Panicum sumatrense*), Proso millet (*Panicumm iliaceum*) and Barnyard millet (*Echinochola utilis*).

The advantages of growing minor millets include drought tolerance, crop sturdiness, short to medium duration, low labour requirement, minimal purchased inputs, resistance to pests and diseases. Millets have been called nutri-grains since they are rich in micronutrients like minerals and B-complex vitamins. Additionally, millets are also rich in health promoting phytochemicals, and can be used as functional foods (ICAR, 2016).

Recently, a transformation from traditional recipes to RTE has been developed utilizing minor millets, ready-to-eat convenience products similar to rice, wheat, sorghum and other cereal flakes are emerging. The flakes could be wetted with

Corresponding author:* **Harini Venugopal
Dairy Science College, KVAFS University, Hebbal, Bengaluru-560024, India

water and seasoned with spicy condiments or sweetened for consumption as snacks. The thicker grade flakes may be deep and fat fried to prepare crispy ready-to-eat snacks. These flakes can be used after toasting or blistering similar to corn flakes (Popuri and Rao, 2016). Extrusion-cooking is increasing popularity in the global agro-food processing industry, particularly in the food and feed sectors to produce RTE food. Food extrusion is a thermo mechanical processing operation that combines several unit operations such as mixing, kneading, shearing, conveying, heating, cooling, forming, partial drying or puffing.

Food materials are plasticized and cooked in a minute by a combination of moisture, pressure, temperature and mechanical shear, resulting in molecular transformation and chemical reactions .It reduces the microbial count and inactivates the enzymes. It is a multi-step, multi-function thermal or mechanical process, has permitted a large number of food applications. Beneficial changes in the bioavailability as well as in the content of nutrients may take place during extrusion. It is being used increasingly in the food industries for the development of new products such as cereal based snacks, including dietary fiber, baby foods, breakfast cereals and modified starch from cereals (Belwal and Deshpande, 2017).

MATERIALS AND METHODS

Expansion Ratio (ER) was estimated according to procedure outlined by Fan *et al*., 1996, Water Solubility Index (WSI) and Water Absorption Index (WAI) and Water Holding Capacity was measured according to the procedure followed by Anderson (1982 a) , Oil Absorption Capacity (OAC) was estimated by the centrifugation method described by Lin and Humbert (1984). The moisture content of all the ingredients and samples is estimated as per IS: SP 18 (Part XI), 1981. The total protein content of the dried samples of ingredients as well as final RTE food is computed by estimating total nitrogen by the Micro kjeldahl method as per procedure given in IS: SP 18 (Part XI), 1981. Fat content is estimated by ether extract method as per the procedure of IS: SP 18 (Part XI), 1981. Total ash content of the developed RTE food is analyzed as per the procedure of IS: SP 18 (Part XI), 1981. Crude fibre of the sample is estimated by using moisture and fat-free samples and expressed as g/ 100g or per cent of the samples used as per AOAC (1984).

Optimization of WPC level in finger millet based RTE food

The proportion of finger millet and corn-wheat (25:75) was blended with malted legume (Horse gram) flour @ 10, 20, 30 and 40 per cent levels. The resultant product was admixed with 20 per cent sugar and further enriched with WPC at 4, 6, 8 per cent levels .It was preconditioned to 22 per cent moisture at 90 ˚C and subjected to extrusion process followed by oil frying at 110ºC. The developed product was subjected to sensory evaluation (9-point hedonic scale) by serving to a panel of 5 judges in order to select the optimum levels of WPC in the finger millet based RTE food. The enriched RTE food product blended with millet, legume and WPC was subjected to Physio-chemical, Functional, Rheological and Sensory studies (Hairnivenugopal *et al*., 2018).

RESULTS AND DICUSSION

Effect of Enrichment With Wpc on Chemical Composition of Finger Millet Based Rte Food

The result pertaining to effect of enrichment with WPC chemical composition of finger millet based RTE food is exhibited hereunder (Table 1 and Fig.1). The moisture content of RTE food had non-significant effect. The control had 3.84 per cent moisture and the WPC enriched product had moisture content which varied from 3.82 to 3.76 per cent. Similar pattern was observed for fat and mineral content of RTE food. The fat content ranged from3.87 to 3.72 per cent for RTE food with 3.99 per cent fat for control. The highest fat content was observed for 8 per cent level of WPC. The mineral content for control was 2.54 per cent whereas the RTE food had 2.58 to 2.65 per cent mineral content for 4-10 per cent WPC enrichment. The enrichment of WPC on RTE food had a tremendous significant effect on protein content. As it is evident form the result that with increase in WPC levels the protein content in RTE food increased. The protein content of control was 12.75 per cent. However the WPC enriched RTE food had 14.99, 16.38, 17.77, 19.17 per cent protein for 4, 6, 8 and 10 per cent levels of WPC, indicating that WPC is rich source of protein. The extent of addition of WPC at 4, 6, 8 and 10 per cent levels had significant effect on carbohydrate content, indicating the decrease of carbohydrate with increase in WPC enrichment. The least carbohydrate content was observed to be for 10 per cent (68.20) and highest was for control (74.63). The commendable observation was noted for the protein content of RTE food based on finger millet. The protein content increased tremendously upon enrichment with WPC at various levels. This result can be focussed to the fact that the WPC contained highest protein content (80.4%) thereby it is being referred as rich protein source. However, decrease in carbohydrate can be noticed on incorporation of WPC this can be attributed to very lower content of carbohydrate profile in WPC. The crude fibre content decreased as WPC increased due to the fact that WPC lacks crude fibre .The result obtained in the investigation is in concord with previous findings of the researchers. (Mahadevaiah, 2011; Suresha, 2016; Yu, 2017).

Effect of Enrichment with Wpc on Functional Properties of Finger Millet Based Rte Food

The result pertaining to effect of enrichment with WPC on functional properties of finger millet RTE food is presented in Table 2 and Fig.2. It was observed that ER, WAI and WSI had non-significant effect on different levels of WPC. The ER ranged from 3.52 to 3.82 g/100 g for WPC treated sample whereas control had 3.31. The WAI for RTE food was observed to be 6.47 to 6.39 g/100 g for 4-10 per cent levels of WPC. The control had 3.52 g/100 g of WSI. Similarly, WHC of control was 142.55 g/100 g whereas the WPC treated product had WHC in the range of 153.60 to 171.79 g/100 g from 4-10 per cent levels highlighting the significant effect of different levels of WPC on finger millet RTE food. The OAC of RTE food had a positive correlation as WPC level increased. The control had 68.18 g/100 g of OAC whereas the RTE food with WPC had 68.94, 69.66, 70.08 and 70.71 g/100 g of OAC indicating the significant effect of WPC.

The ER slightly increased with the proportions of finger millet. This was caused by transformation of biopolymer study, nucleation, swelling of extrudate, bubble growth in melt and bubble collapse. The increased ER was observed in the investigation. The WAI and WSI of finger millet RTE food varied from 6.57 to 6.39 g/100 g and 3.52 to 3.24 g/100 g, respectively. This reason behind this is that the solubility of extrudates caused by starch conversion during extrusion which is resulted by WPC. The WHC of finger millet based RTE food increased with increase in WPC levels from the results; it is observed that WHC increased from 142.55 to 171.79 g/100 g indicating the higher water holding capacity of WPC. (Yu *et al*., 2011). OAC of finger millet based RTE food indicates the increase trend as the levels of WPC is added. The varied trend is mainly because the hydrophobicity of proteins which is known to play a major role in fat absorptions. This helps to resist physical entrapment of oil by capillary of non-polar side chains of amino acids of protein molecules. These statements can be justified with the results obtained in the research findings that OAC of finger millet RTE food varied between 68.94, 69.66, 70.08 and 70.71 g/100 g, respectively for 4, 6, 8 and 10 per cent of WPC. The results are in close agreement with investigators who have reported similar findings in various formulaion of RTE food (Kneifel and Seiler, 1993, Okafor and Usman, 2015).

CONCLUSION

Food industries are focusing energies towards the development of functional foods and food ingredients. Processing of millets to incorporate them in ready-to-eat foods can increase their nutritional value, availability and economic value besides improving farmer's income. Utilization of dairy by-product WPC in RTE foods makes significant improvement in the chemical and functional properties of the RTE foods with respect to higher protein content and decrease in carbohydrates which is need of hour today. Further, RTE food incorporated with finger millet improves crude fiber content in the final product. Thereby justifying that utilization underutilized nutria-rich minor millets, protein rich legumes and functional and nutraceutical dairy by-products (WPC) in RTE foods not only results in nutritionally superior product but is also economical and it could be designated as almost complete food with good marketing potentiality.

Table 1 Effect of WPC on chemical composition of finger millet based RTE food

Levels of WPC	Moisture	Fat	Protein	Crude fibre	Mineral	Carbohydrate
			Per cent			
Control	3.84[a]	3.99[a]	12.25[a]	2.75[a]	2.54[a]	74.63[a]
4	3.82[a]	3.87[a]	14.99[b]	2.64[b]	2.58[a]	72.10[b]
6	3.80[a]	3.82[a]	16.38[c]	2.59[c]	2.60[a]	70.81[c]
8	3.78[a]	3.77[a]	17.77[d]	2.54[d]	2.63[a]	69.51[d]
10	3.76[a]	3.72[a]	19.17[e]	2.50[e]	2.65[a]	68.20[e]
CD (P = .05)	0.13	0.33	1.51	0.03	0.18	1.12

* All values are average of three trails
Similar super scripts indicate non-significance at the corresponding critical difference (CD)

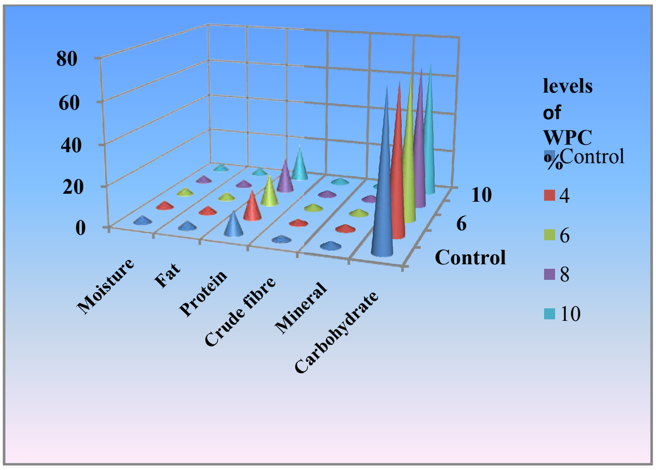

Fig 1 Effect of WPC on chemical composition of finger millet based RTE food

Table 2: Effect of WPC on functional properties of finger millet based RTE food

Levels of WPC (%)	ER	WAI	WSI	WHC	OAC
			(g/100g)		
Control	3.31[a]	6.57[a]	3.52[a]	142.55[a]	68.18[a]
4	3.52[a]	6.47[a]	3.40[a]	153.60[b]	68.94[b]
6	3.63[a]	6.45[a]	3.34[a]	159.50[c]	69.66[c]
8	3.80[a]	6.41[a]	3.29[a]	165.60[d]	70.08[d]
10	3.82[a]	6.39[a]	3.24[a]	171.79[e]	70.71[e]
CD (P = .05)	0.62	0.22	0.31	4.81	0.36

* All values are average of three trails
* Similar super scripts indicate non-significance at the corresponding critical difference (CD)
* ER – Expansion Ratio, WAI-Water Absorption Index, WSI- Water Solubility Index, WHC-Water Holding Capacity, OAC- Oil Absorption Capacity.

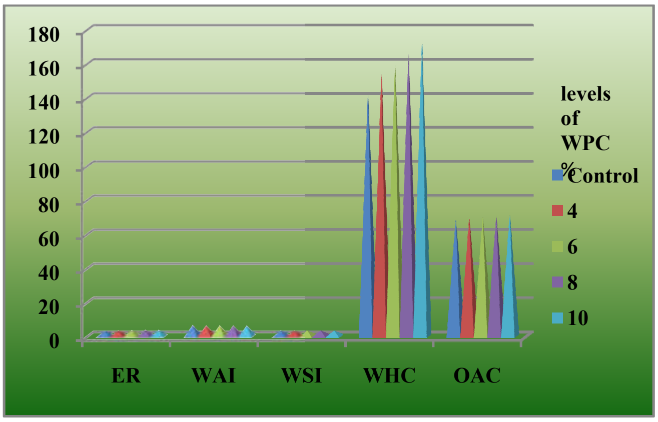

Fig 2 Effect of WPC on functional properties of finger millet based RTE food

Refrences

Alok, C. and Kanawaajia, 2010. Whey Proteins For Health Living. *Indian Dairyman.*, 62 (4):66-73.

Anderson, R.A. 1982a. Water Absorption And Solubility And Amylograph Characteristics Of Roll-Cooked Small Grain Products. *Cereal Chemistry.,* 59: 265– 269.

Aoac, 1980. Official Methods of Analysis. 13th Ed., Association of Official Agricultural Chemist, Washington, D.C.

Belwal and Deshpande, 2017. Extrusion Technology And Effect of Extrusion Process on Food Quality Parameters Involving Fortification Process. *Indian Food Industry.,* 36 (1): 11-21.

Fan, J., Mitchell, J. R. and Blanchard, J.M.V. 1996. The Effect Of Sugars On The Extrusion Of Maize Grits: The Role Of The Glass Transition in Determining Product Density And Shape. *International Journal of Food Science And Technology.,* 31: 55-65.

Harinivenugopal, Jayaprakasha, H.M. and Arunkumar, H.2018.Technological Intervention In Developing Finger Millet Based Ready To Eat (Rte) Food. *International Journal Of Trend In Research And Development.*, 5 (3): 2394-9333.

Is Sp: 18 (Part Xi), 1981. Isi Hand Book of Food Analysis, Part Xi Dairy Products, Indian Standards Institute, Manak Bhavan, New Delhi

Icar, 2016. Special Issue On Small Millets. *Indian Farming*., 65 (12):1-92.

Jayaprakasha, H.M. and Brueckner, H. 1999. Whey Protein Concentrate: A Potential Functional Ingredient For Food Industry. *J. Food Sci.Technol*., 36 (3): 189-204.

Kneifel And Seiler, 1993. Water Holding Properties Of Milk Protein Products - A Review. *Food Structure.,*12: 297-308.

Lin and Humbert, E.S. 1984. Certain Functional Properties Of Sun Flower Meal Products. *J. Food Sci.,* 139(2) : 368–70.

Mahadevaiah, 2011. Process Development For Ready To Use Functional Weaning Food. Phd Thesis Submitted To Kvafsu, Bidar.

Okafor, G.I. and Usman, G.O. 2015. Physical And Functional Properties Of Breakfast Cereals From Blends Of Maize, African Yam Bean, Defattened Coconut Cake And Sorghum Extract. *International Journal Of Food And Nutritional Sciences*., 4 (3): 109-116.

Papuri, S.K. and Rao, D.2016. Millets For New World. *Indian Farming.,*65 (12): 89-91.

Suresha, K.B. 2016. Development Of Ready To Use Millet Based Complementary Health Food. M.Sc. (Dairy Science) Thesis Submitted To Karnataka Veterinary Animal and Fisheries Sciences, Bengaluru.

Yu, Junfei Tang, Shena and Shaowei Liub, 2017. Correlations Between The Physical Properties And Chemical Bonds Of Extruded Corn Starch Enriched With Whey Protein Concentrate. *The Royal Society of Chemistry.,*7:11979–11986.

Yu., L. 2011. Extrusion Processing of Protein Rich Food Formulations. Department of Food Science And Agricultural Chemistry Mcgill University, Montreal, 1-209.

How to cite this article:

Harini Venugopal., H.M *et al.* 2018, Whey Protein Concentrate (Wpc) – A Nutraceutical Ingredient in The formulation of Finger Millet Based Ready- to- Eat (Rte) Food. *Int J Recent Sci Res.* 9(7), pp. 28235-28238.

DOI: http://dx.doi.org/10.24327/ijrsr.2018.0907.2421

****