



Research Note

Recovery of Protein from Lizardfish (*Saurida tumbil*) Surimi-leached Water using Spray Drying Technique

V. B. Mulye*, S. M. Zofair, J. K. Gohel, R. M. Kadri and K. G. Baraiya

College of Fisheries, Junagadh Agricultural University, Junagadh - 362 001, India

Lizardfish is one of the most important fish species used for the production of surimi. The annual landing of lizardfish is 55 800 t in India (CMFRI, 2012). In surimi processing, washing is an important step where water-soluble proteins are removed to improve gel forming ability of surimi. The leached water contains 0.5 to 2.3% protein (Lin et al., 1995; Morrissey et al., 2000). Considerable amount of edible fish proteins present in leached water can be recovered by using any suitable and effective method. Protein lost in waste water by leaching accounts for 15 to 30% of the total protein of minced meat (Okazaki, 1994), which is discarded as effluent. If leached water from surimi processing plants is released without recovering protein, it causes organic pollution (Jaouen & Quemeneur 1992). Recovering protein from waste water may provide an additional source of fish protein as ingredient for the food industry (Stine et al., 2011). The recovered protein can be effectively utilized by mixing with surimi in an appropriate proportion (Zhang et al. 1999). Effective recovery of soluble protein enables efficient utilization of the marine resources and cost reduction in surimi production (Okazaki, 1994).

Methods for recovery of washed water proteins include pH adjustment (Nishioka & Shimizu, 1983), heat treatment, complexing agents, electro-coagulation (Hasegawa et al. 1982), membrane filtration (Green et al., 1984) and air flotation (Beck et al. 1974). Attempts were made to recover protein from surimi waste water (Zhang et al., 1999; Niki et al., 1985; Mohammad et al., 2002) using different technolo-

gies. Spray drying is one of the methods used in food processing industry for recovery of ingredients from aqueous extracts. The aim of this study was to recover proteins from leached water generated in surimi industry, by spray drying technique and to assess the quality of the recovered protein.

Fresh lizardfish (*Saurida tumbil*) was collected from Veraval fishing harbor, Gujarat and transported in chilled condition to the laboratory. Fish was dressed and meat was collected. The meat was minced and washed repeatedly for three times with chilled (6 to 8°C) water with each cycle of 10 min. Leaching ratio of water and fish was 3:1. Leached water was collected and a fraction of it was spray dried. Powder collected was stored at room temperature in a PET jar for analysis of proximate composition, colour, trimethylamine (TMA), total volatile base nitrogen (TVB-N), total plate count (TPC) and functional properties. Storage study of 90 days was carried out by analyzing physical, chemical and microbiological parameters at 15 day intervals.

Proximate composition was analyzed by following AOAC (2006) method; TMA and TVB-N of protein by micro diffusion method as per Beatty & Gibbons (1937). Enumeration of TPC was done as per AOAC (2006) using Trypton Glucose Beef Extract (TGBE) agar. Water holding capacity (WHC) and protein solubility of recovered protein were estimated as per Vojdani (1996). Colour of protein powder was measured using a colour reader (Model CR-10. Konica minolta sensing, Inc. Japan).

All measurements were made in five replicates for each sample.

Result and Discussion

Proximate composition of the spray-dried leached water from surimi operations was as follows:

Received 18 September 2013; Revised 02 September 2014; Accepted 15 November 2014

* E-mail: mulyevijayb@gmail.com

moisture $6.72 \pm 0.07\%$, protein $75.55 \pm 0.40\%$, fat $1.03 \pm 0.05\%$ and ash $13.04 \pm 0.05\%$ (Table 1). Kanpairo et al. (2012) reported proximate composition of spray-dried tuna flavour powder in the range of 4.63 to 7.46% moisture, 28.49 to 42.06% protein, 0.87 to 1.00% lipid, 3.44 to 4.25% ash and 10.88 to 16.76% salt. Protein powder recovered in this experiment had a significantly higher protein and same level of fat content compared to fish protein concentrate reported by Balchandran (2001). This result is also in accordance with results of Shaviklo et al. (2012) of surimi powder made from saithe (*Pollachius virens*) by spray drying. Proximate composition of recovered protein powder remained more or less stable during 90 days of storage.

TMA-N and TVB-N increased from 2.71 ± 0.09 to 7.54 ± 0.41 mg 100 g⁻¹ and 7.58 ± 0.40 to 12.08 ± 0.09 mg 100 g⁻¹ respectively during the storage period (Table. 2), which is in the limit of acceptability (Mukundan & Balasubramanian, 2011). TVB-N

values increased with the storage period but never crossed the limit of acceptability of 35-40 mg 100 g⁻¹ as suggested by Lakshmanan (2000). However there was a gradual increase in TPC from 2.0×10^3 to 3.2×10^3 cfu g⁻¹ on 90th day (Table 2). Sen (2005) reported average total bacterial count up to 1.5×10^4 cfu g⁻¹ for fish protein concentrate. The TPC of the protein powder was within the acceptable limit during storage period.

Colour parameters at the end of storage period were *L* (lightness) 77.64 ± 0.11 , *a* (redness/greenness) 2.66 ± 0.11 and *b* (yellowness/blueness) 20.8 ± 0.07 with whiteness 69.35 are shown in Table 3. No notable changes in colour were observed during the period of storage. Huda et al. (2001) reported '*L*' 85.59, '*a*' 0.30 and '*b*' 16.38 for lizardfish surimi powder. This difference may be attributed to the difference in the method of drying. Similar result was observed in spray-dried tuna flavour powder by Kanpairo et al. (2012) where *L* value was 80 to

Table 1. Changes in proximate composition of protein powder during storage

Storage period (Days)	Moisture (%) (mean±SD)	Protein (%) (mean±SD)	Fat (%) (mean±SD)	Ash (%) (mean±SD)
0	6.72 ± 0.07	75.55 ± 0.40	1.03 ± 0.05	13.04 ± 0.05
15	6.93 ± 0.07	75.16 ± 0.11	1.03 ± 0.04	13.82 ± 0.13
30	7.08 ± 0.06	75.02 ± 0.06	1.01 ± 0.04	13.89 ± 0.13
45	7.43 ± 0.34	74.86 ± 0.15	0.98 ± 0.07	13.93 ± 0.04
60	7.52 ± 0.06	74.47 ± 0.36	0.95 ± 0.05	14.07 ± 0.08
75	7.82 ± 0.59	74.09 ± 0.38	0.86 ± 0.09	14.19 ± 0.14
90	8.02 ± 0.13	73.91 ± 0.08	0.79 ± 0.04	14.28 ± 0.33

Table 2. Changes in chemical and microbiological parameters of protein powder during storage

Storage period (Days)	TMA (mg%) (mean±SD)	TVB-N (mg%) (mean±SD)	TPC (CFU g ⁻¹)
0	2.71 ± 0.09	7.58 ± 0.40	2.0×10^3
15	3.48 ± 0.06	7.93 ± 0.10	2.2×10^3
30	5.49 ± 0.09	8.03 ± 0.06	2.5×10^3
45	5.82 ± 0.09	8.98 ± 0.09	2.7×10^3
60	6.15 ± 0.15	9.56 ± 0.43	2.9×10^3
75	6.98 ± 0.09	11.92 ± 0.26	3.1×10^3
90	7.54 ± 0.41	12.08 ± 0.09	3.2×10^3

Table 3. Changes in colour of protein powder during storage

Storage period (Days)	L-value (mean±SD)	a-value (mean±SD)	b-value (mean±SD)	Whiteness $W=\sqrt{(100-L)^2 + a^2 + b^2}$
0	80.82 ± 0.10*	0.46 ± 0.05	18.34 ± 0.05	73.46
15	80.42 ± 0.08	0.82 ± 0.08	18.86 ± 0.05	72.80
30	79.68 ± 0.08	1.2 ± 0.12	19.2 ± 0.07	72.02
45	79.46 ± 0.05	1.46 ± 0.05	19.5 ± 0.07	71.64
60	79.24 ± 0.08	1.76 ± 0.05	19.84 ± 0.05	71.23
75	78.74 ± 0.13	2.14 ± 0.05	20.12 ± 0.13	70.65
90	77.64 ± 0.11	2.66 ± 0.11	20.8 ± 0.07	69.35

*Values are averages of five replicates along with standard deviations and expressed in percentage

84.38, 'a' value was 3.23 to 4.50 and 'b' value between 18.5 to 22.52.

Recovered protein from surimi leach water had mean solubility and mean WHC of $34 \pm 0.59\%$ and $4.22 \pm 0.03 \text{ ml g}^{-1}$ respectively (Table 4). Fawzya et al. (1998) reported water solubility of 38.27% for croaker flour obtained by spray drying technique. Similar result of WHC of threadfin surimi powder ($3.00 \pm 0.08 \text{ ml g}^{-1}$) was observed by Abdullah et al. (2012). Solubility and WHC of spray-dried protein powder from this experiment was higher than the values of oven-dried surimi powder as 28.1% and 2.8 ml g^{-1} respectively of lizard fish reported by Huda et al. (2000). This shows the superiority of spray drying technique over other methods of drying due to good functional properties of the former.

Table 4. Changes in solubility (%) and water holding capacity (%) of protein powder during storage

Storage period (Days)	Solubility (%) (mean±SD)	WHC (ml gm ⁻¹) (mean±SD)
0	37.00 ± 0.70	4.76 ± 0.11
15	36.00 ± 0.71	4.50 ± 0.16
30	36.00 ± 0.71	4.50 ± 0.16
45	35.00 ± 0.70	4.30 ± 0.10
60	33.00 ± 0.71	4.10 ± 0.10
75	32.00 ± 0.71	3.80 ± 0.07
90	29.00 ± 0.71	3.60 ± 0.14

Based on the results obtained from the study of 90 days duration, it is clear that spray drying technique is effective to recover water-soluble proteins from surimi leached-water. The study showed that there is scope of recovery of about 3% mineral-rich, stable functional protein from the leached water using spray drying technique.

Acknowledgements

The authors are thankful to the Vice-Chancellor and Director of Research & Dean P. G. Studies, Junagadh Agricultural University, Junagadh, for providing facilities to carry out chemical analysis at Food Testing Laboratory, Junagadh.

References

- AOAC (2006) Official Methods of Analysis, 18th edn., Association of Official Analytical Chemists, Washington, DC
- Abdullah, R., Santana, P., Huda, N. and Yang, T. A. (2012) Functional Properties of Threadfin Bream Surimi Powder Added with Different Dryoprotectants UMT 11th International Annual Symposium on Sustainability Science and Management 09th – 11th July, 503-508
- Balchandran, K. K. (2001) Post-Harvest Technology of Fish and Fish Products. 402p, Daya Publishing House, Delhi
- Beatty, S. A. and Gibbons, N. E. (1937) The measurement of spoilage in fish. J. Biol. Board Canada, 3: 77-91
- Beck, E. L., Giannini, A. P. and Ramirez, E. R. (1974) Electrocoagulation Clarifies Food Wastewater. Food Technol. 28: 18-24
- CMFRI (2012) Annual Report 2011-12, 13p, Central Marine Fisheries Research Institute, Cochin

- Fawzya, Y. N., Dwiyituo, Irianto, H.E. and Rosmawaty, P. (1998) Processing of Fish Flour from Croaker (*Pseudociena amoyensis*), IPB, Bogor Agricultural University, West Java, pp 119-124
- Green, D. P., Tzou, L., Chao, A. C. and Lanier, T. C. (1984) Strategies Form Handling Soluble Wastes Generated in Minced Fish (Surimi) Production. pp 562-572, Proc. 39th Ann. Purdue Industrial Waste Conf. Purdue University
- Hasegawa, Watanabe, H. and Takai, R. (1982) Methods of Electrocoagulation. Bull. Jap. Soc. Sci. Fish. 50: 659-663
- Huda, N., Abdullah, A. and Babji, A. S. (2000) Effects of cryoprotectants on functional properties of dried lizardfish (*Saurida tumbil*) surimi. Malays Appl Biol. 29(1&2): 9-6
- Huda, N., Abdullah, A. and Babji, A. S. (2001) Functional properties of surimi powder from three Malaysian marine fish. Int. J. Food Sci. Technol. 36: 402-406
- Jaouen, P. and Quemeneur, F. (1992) Membrane filtration for waste-water protein recovery. In: Fish Processing Technology (Hall, G. M., Ed), pp 212-248, Chap-man & Hall, New York
- Kanpairo, K., Usawakesmanee, W., Sirivongpaisal, P. and Siripongvutikorn, S. (2012) The compositions and properties of spray dried tuna flavor powder produced from tuna precooking juice, Food Res. Int. 19 (3): 893-899
- Lin, T. M., Park, J. W. and Morrissey, M. T. (1995) Recovered protein and reconditioned water from surimi processing waste, J. Food Sci. 60: 4-9
- Lakshmanan, P. T. (2000) Fish spoilage and quality assessment. In: Quality Assurance in Seafood processing (Iyer, T. S. G., Kandoran, M. K., Thomas M. and Mathew, P. T., Eds), pp 26-40, Society of Fisheries Technologists (India), Cochin
- Morrissey, M. T., Park, J. W. and Huang, L. (2000) Surimi processing waste. Its control and utilization. In: Surimi and Seafood (Park, J.W., Ed) Marcel Dekker, New York. pp 127-165
- Mohammad, A.W., Anuar, N. and Rahman, R. A. (2002) Potential use of nanofiltration membrane in treatment waste water from fish and Surimi industries. J. Sci. Tech. 24: 977-987
- Mukundan, M. K and Balasubramanian, S. (2011) Seafood Quality Assurance, 123p, Central Institute of Fisheries Technology
- Nishioka, F. and Shimizu, Y. (1983) Recovery of Proteins from Washings of Minced Fish Meat by pH Shifting Methods. Bull. Jap. Soc. Sci. Fish. 49: 795-800
- Niki, H., Kato, T. and Lgarashi, S. (1985) Recovery of Protein from Effluent of Fish Meat in Producing Surimi and Utilization of Recovered Protein. Nippon Suisan Gakkaishi, 51(6): 959-964
- Okazaki, E. (1994) A Study on the Recovery and Utilization of Sarcoplasmic Protein of Fish Meat Discharged During the Leaching Process of Surimi Processing. Bulletin of The National Research Institute of Fisheries Science 6: 79-160
- Sen D. P. (2005) Advance in Fish Processing Technology, 490p, Allied publishers Pvt. Limited
- Shaviklo, G. R., Thorkelsson, G., Arason, S. and Sveinsdottir, K. (2012) Characteristics of freeze-dried fish protein isolated from saithe (*Pollachius virens*). J. Food Sci Technol. 49(3): 309-318
- Stine, J. J., Pedersen, L., Smiley, S. and Bechtel, P.J. (2011) Recovery and utilization of Protein derived from surimi wash-water, J. Food Quality, 35: 43-50
- Vojdani, F. (1996) Method of testing protein functionality. In: Solubility (Hall G. M., Ed), pp 11-55, Blackie Academic and Professional, London
- Zhang., Zong'en., Wang., Zhihe., Xiao., Anhua., Zou., Yitian., Zhang., and Chun, J. (1999) Recovery and utilization of water soluble fish protein from Surimi washings. J. Shanghai Fish. Univ./Shanghai Shuichan Daxue Xuebao, 8(1): 59-62