Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

JEZS Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(5): 2202-2208

Received: 22-07-2018
Accepted: 26-08-2018

Gaikwad BV
College of Fisheries, Shirgaon,
Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli, Ratnagiri, Maharashtra,
India

Pagarkar AU
Marine Biological Research Station,
(Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli)
Ratnagiri, Maharashtra, India

Chogale ND
Marine Biological Research Station,
(Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli)
Ratnagiri, Maharashtra, India

Mohite SA
College of Fisheries, Shirgaon,
Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli, Ratnagiri, Maharashtra,
India

Chaudhari KJ
College of Fisheries, Shirgaon,
Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli, Ratnagiri, Maharashtra,
India

Kudale AS
College of Fisheries, Shirgaon,
Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli, Ratnagiri, Maharashtra,
India

Satam SB
Marine Biological Research Station,
(Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli)
Ratnagiri, Maharashtra, India

Bhosale BP
College of Fisheries, Shirgaon,
Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli, Ratnagiri, Maharashtra,
India

Sawant NH
Fisheries Research Unit,
(Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli) Mulde, Kudal, Dist.
Sindhudurga on, Maharashtra, India

Correspondence
Gaikwad BV
College of Fisheries, Shirgaon,
Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli, Ratnagiri, Maharashtra,
India

Effect of washing processes on quality parameters of surimi prepared from Lesser sardine (*Sardinella* spp.)

Gaikwad BV, Pagarkar AU, Chogale ND, Mohite SA, Chaudhari KJ, Kudale AS, Satam SB, Bhosale BP and Sawant NH

Abstract
Lesser sardine (Sardinella spp.) is one of the pelagic shoaling fish mainly landed in huge quantity at Ratnagiri coast. These species of fish have high percent of fat and myoglobin, which effects the quality of surimi produced. The gel strength characteristic of surimi can be improved by using different washing processes. The gel strength characteristic plays important role in preparation of crab/lobsters analogues and other surimi based products. Effect of washing processes *viz*., conventional washing process (CWP) and alkaline-saline washing process (ASWP) on surimi was compared with unwashed mince (UWM) prepared from Lesser sardine. In the present investigation, surimi were analysed for parameters like gel strength, whiteness, expressible moisture, pH, solubility and organoleptic characteristics. Gels strength of unwashed mince (UWM) and different washing processes like CWP and ASWP were depicted as 28.67, 42.00 and 68.00 g/cm respectively. High values of whiteness and pH with decreasing expressible moisture content was observed in ASWP as compared to others. The results showed that alkaline-saline washing process (ASWP) could improve the gel forming ability of surimi particularly from low quality fatty fish (*Sardinella* spp.).

Keywords: Lesser sardine, washing processes, surimi, gels strength, quality improvement

1. Introduction

Surimi is deboned, washed and stabilized fish mince containing myofibrillar protein added with cryoprotectants and frozen [18]. Surimi is basic raw material for development of various value added products such as crab analogues, scallop analogues, shrimp/lobster analogue, fish ball and other surimi based products. These products have excellent nutritional values and they are available in ready to eat and ready to cook, convenient products to the consumers [25, 24]. Consumer's health can be potentially improved by consumption of health-promoting seafood products. These products have good demand in national and international market [23].

Lean fishes are generally used for surimi production. Presently, the catch of lean fishes from sea is declining due to over exploitation of these fishes and there is urgent need to utilize fatty pelagic fishes for surimi production. Lesser sardine (*Sardinella* spp.) are pelagic, fatty, shoaling fishes, whichare landed in huge quantity on Ratnagiri coast of India. These fatty fishes need to be used for the production of surimi for its better utilization. However, problems faced with production of surimi from these fatty fish species, such as Lesser sardine (*Sardinella* spp.) are dark muscle associated with high content of lipid and myoglobin, resulting difficulties in making high quality surimi [11, 14]. The washing technique is used as an important tool to improve the quality of surimi. A huge amount of water is used to remove the water-soluble proteins, blood, fat and other nitrogenous compounds from the minced fish flesh [16].

Washing process shows great significance on final quality of the surimi, which removes sarcoplasmic protein and increases the concentration of the myofibrillar proteins. This increase in myofibrillar proteins improves the ability to gel formation [19, 5]. However, no information is available on effect of washing processes on surimi quality such as, colour, gel strength and other properties from species Lesser sardine (S*ardinella* spp.) caught from Ratnagiri coast. Therefore, in the present study the effect of Lesser sardine surimi prepared from conventional washing processes (CWP) and alkaline saline washing processes (ASWP) compared with unwashed mince and its functional and other gel properties were studied.

2. Materials and methods

Lesser sardine (S*ardinella* spp.) with an average weight of 35-38 g was brought in ice (fish/ice ratio 1:2) condition from the landing center. The fish was washed, drained, dressed, mechanically deboned by mincer with a hole diameter of 5 mm. The minced meat prepared by this process was referred as ‘‘Unwashed mince’’.

This unwashed mince (UWM) added with cryoprotectants (4% sugar and 0.2% polyphosphates) were added and mixed well. UMW was packed in polyethylene bag, sealed and frozen using plate freezer at – 40 ^{0}C [6].

This unwashed mincedwas further used to study effect of different washing processes on surimi quality.

2.2.2 Preparation of surimi by conventional washing processes

Unwashed mince (UWM) was suspended in cold water (5 ^{0}C) at a ratio 1:3 (mince/water w/w). The mixture was stirred gently for 4 min and washed mince was filtered with a layer of muslin cloth. The washing process was repeated twice. For the third washing, cold water containing 0.5% NaCl solution [9] was used. Finally, the water was removed from washed minced manually. Then cryoprotectantswere added, packed and frozen as prepared surimi previous lydescribed. This processes of surimi production was referred as ‘‘Conventional washing process surimi’’ (CWP).

2.2.3 Preparation of surimi by alkaline-saline washing processes

Unwashed mince (UWM) was suspended in cold (5 ^{0}C) alkaline-saline water (0.15% NaCl in 0.2% $NaHCO_3$) at a mince/water ratio of 1:4 (w/w) [27]. The mixture was stirred gently for 15 min and washed mince was filtered with a muslin cloth. The washing process was repeated twice. For the third washing, cold water containing 0.5% NaCl solution was used and thereafter water was removed from washed minced manually. Then cryoprotectants were added, packedand frozen as prepared surimi previously described. This process of surimi production was referred as ‘‘Alkaline-saline washing process surimi’’ (ASWP).

The stabilized mince and surimi were stored at -18 ^{0}C and used for analysis of gel properties.

2.3 Analysis of surimi gels

2.3.1 Textural analysis

Textural analysis of gels was performed using a texture analyser (Rheo Tex Type: SD-700, Japan). Prepared surimi gels were cut into five cylindrical shaped pieces of 2.5 cm in length. The breaking force (gel strength) and deformation (elasticity/deformability) were measured using the texture analyser equipped with a cylindrical plunger (5 mm diameter; 60 mm per min penetration speed). Measurements were taken in triplicates.

2.3.2 Determination of whiteness

Whiteness was measured using whiteness meter (Nipppon Denshoku, color meter ZE-6000; Japan), Measurements of L*(lightness), a* (red hue to green hue), and b* (yellow hue to blue hue) were made on five replicate samples of each gel. The whiteness was calculatedusing the following equation [2].

Whiteness = $100-[(100- L^*)^2 + a^{*2} + b^{*2}]^{1/2}$

2.3.3 Determination of expressible moisture content

Expressible moisture content was measured according to the method of [4] with slight modification.

$$Expressible\ moisture\ content(\%) = 100[(X \times Y)/X]$$

2.3.4 Determination of pH

pH was measured using pH meter (Equiptronic, digital pH meter model EQ- 610). Surimi gel (5 g) was weighed and homogenised with 45 ml of distilled water at a speed of 800 rpm for 1 min and filtered using a filter paper (Whatman paper No. 1). The pH of filtrate was recorded using a pH meter.

2.3.5 Solubility determination

Solubility, 2 g of surimi was mixed with 18 mlof 0.05 M buffer solution (borate buffer solution, pH 8.1 to 11.50), and homogenized at setting 3 min. (Model RQ-127 A; Vasai. India). After waiting for 30 min., the homogenates were centrifuged at 2450 x g for 15 min at 4 ^{0}C (Hettch, universal 32 R Ref. Centrifuge). Protein concentration of the supernatant was measured by Bradford [8] method.

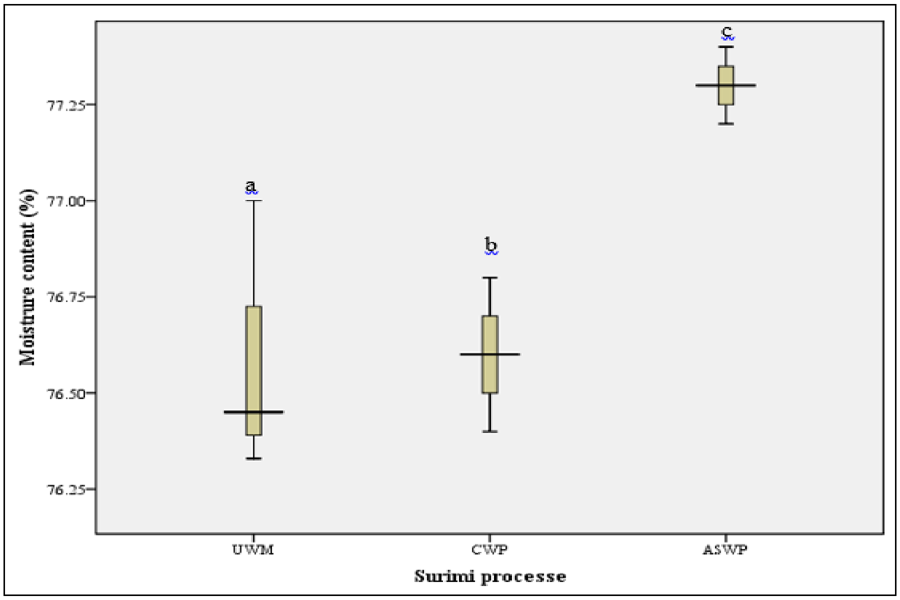
2.3.6 Statistical analysis

All analyses were carried out in triplicates and data expressed as means ± standard error. Analysis of variance (ANOVA) were carried out to assess significant differences between means (p<0.05).Comparison of means was carried out by Student–Newman-Keuls (SNK). Analysis was performed using a SPSS package (SPSS 16.0 for Windows).

3. Result and discussions

3.1 Moisture content of surimi prepared from Lesser sardine, unwashed mince and different washing processes.

ASWP surimi showed slightly higher moisture content (76.30%) followed by CWP (75.60%) and UWM (75.30%) as showed in (Fig.3.1) (p<0.05).Alvarez- Parrilla *et al*. [1] reported moisture contents ranging from 74 to 78% for the surimi is prepared from of horse mackerel (*Trachurustrachurus*) and hake (*Merlucciusmerluccius*). Fogaca *et al*. [13] found that 75.44% moisture in the surimi prepared from Nile tilapia filleting residues performing three washings with distilled cold water and adding 2% NaCl and 1% saccharose. Increase in moisture content in washed meatmay be due to the process of washing. During washing some amount of water is held by the meat as reflected by the increase in moisture percent in washed meat as compared to unwashed meat. The hydrophobic residues of myofibrillar proteins may be responsible for retention of water [12].

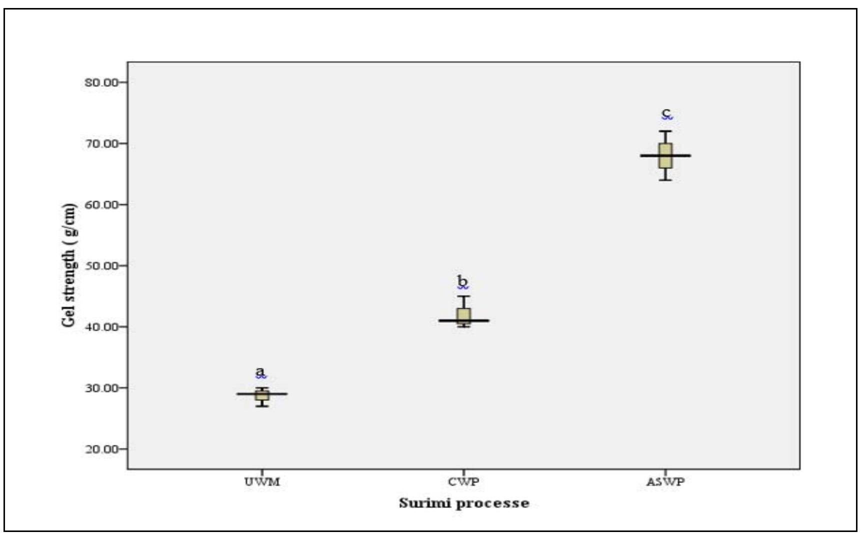


Note: a, b, and c letters on the bars within the same washing treatments indicate the significant differences ($p<0.05$).

Fig 3.1: Moisture content of surimi prepared from Lesser sardine unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP).

3.2 Gel strength of surimi prepared from Lesser sardine, unwashed mince and different washing processes

Variation in gel strength was observed in unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP). However, ASWP showed the highest gel strength (68.00 g/cm) followed by CWP and UWM **(**Fig.3.2**)** ($p<0.05$).Similarly slight variation in gel strength was reported by [2]. They found that mackerel surimi gels showed highest breaking force and deformation in ASWPS, followed by CWP and unwashed mince. Therefore, washing process, particularly alkaline-saline washing, played animportant role in the improvement of gel strength of Lesser sardine surimi. Shimizu *et al*. [28] reported that Pacific mackerel mince washed by alkaline-saline leaching method had showed increase in gel strength by 10-fold, as compared with unwashed mince. Only a two to three fold increase in gel strength was found in mince washed by conventional processes. The higher gel forming ability because of myofibrillar proteins having higher MHC, contribute to gel formation [6].

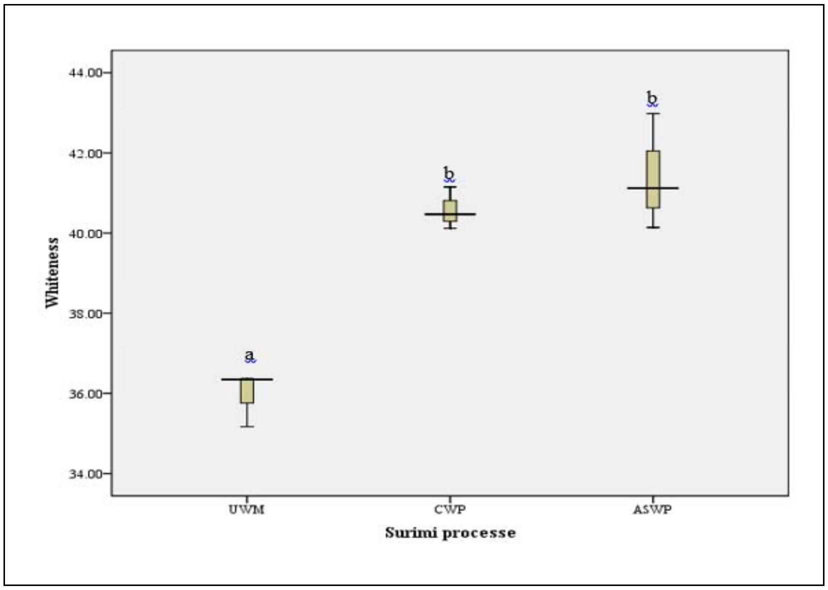


Note: a, b, and c letters on the bars within the same washing treatments indicate the significant differences ($p< 0.05$).

Fig 3.2: Gel strength of surimi prepared from Lesser sardine unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP).

3.3 Whiteness of surimi prepared from Lesser sardine, unwashed mince and different washing processes

Gels prepared from unwashed mince had the lowest whiteness (35.96), compared with those from CWP and ASWP (Fig.3.3). Gel from ASWP was the higher whiteness than that from CWP ($p<0.05$). This indicates that alkaline-saline washing process was more effective in removing pigments, especially myoglobin and hemo-globin from the mince than typical washing process. Balange and benjakul [3] reported the alkaline-saline washing process was more effectively for whiteness. The final colour of the surimi is due to the loss of lipids, blood, carotenoids and other pigments during the washings of the muscle [10]. More washing resulted in the removal of most of the pigment, blood, impurities and improve the whiteness of the Lesser sardine surimi.

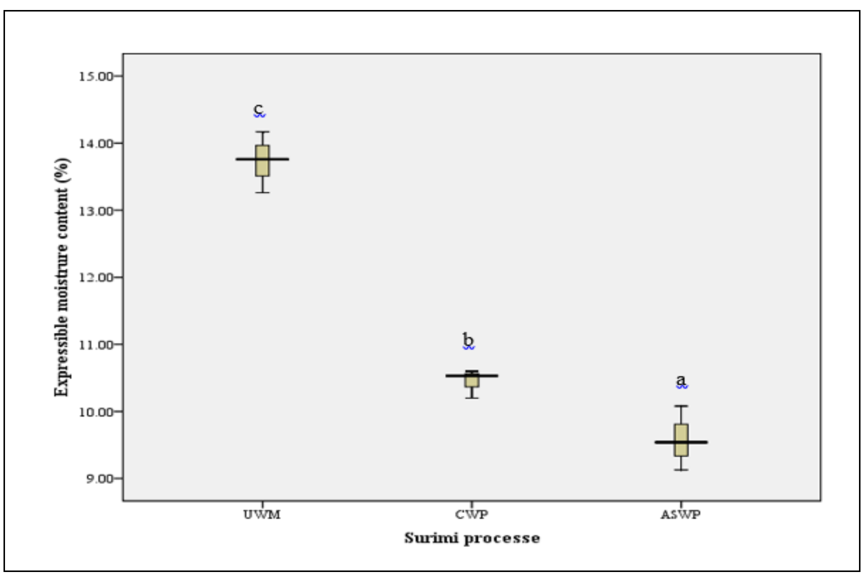


Note: a and b letters on the bars within the same washing treatments indicate the significant differences ($p < 0.05$).

Fig 3.3: Whiteness of surimi prepared from Lesser sardine unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP).

3.4 Expressible moisture content of surimi prepared from Lesser sardine, unwashed mince and different washing processes

Expressible moisture content of surimi gels prepared from Lesser sardine, unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP) showed lowest expressible moisture content in ASWP followed by CWP and UWM as shown in Fig. 3.4. As thegel strength increases the expressible water% decreases [30] (Fig.3.2). The results suggested that the formation of stronger network induced by washing processes might imbibe more water. This is in accordance with increase in gel strength and decease in expressible moisture in the surimi obtained with more number of the washing cycles. This indicates that the quality of surimi gel improved with increasing washing cycles [17].

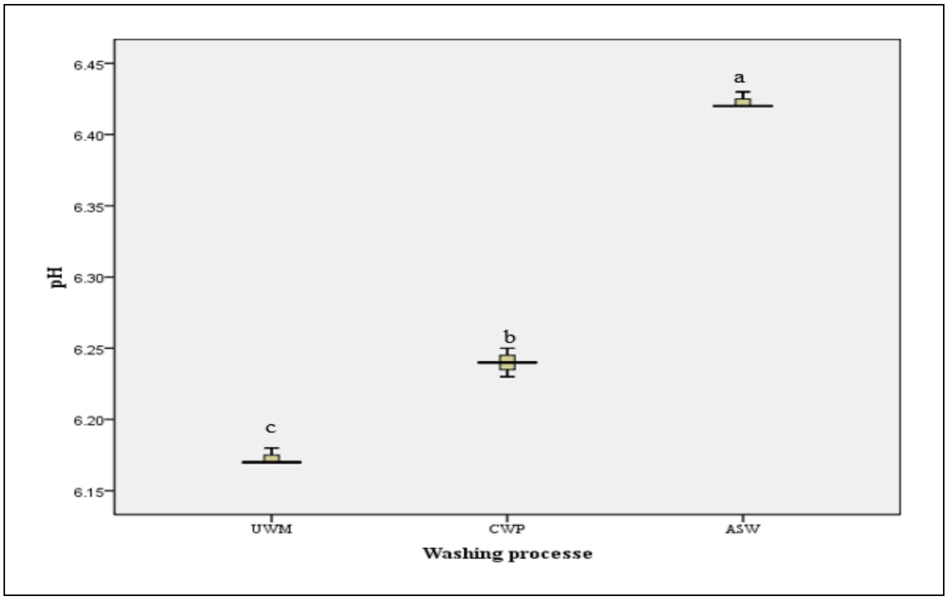


Note: a, b and c letters on the bars within the same washing treatments indicate the significant differences ($p < 0.05$).

Fig 3.4 Expressible moisture content of surimi prepared from Lesser sardine unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP).

3.5 pH values of gels prepared from unwashed mince and surimi prepared by different washing processes

In present study, surimi prepared by ASWP showed improved pH value (6.42) followed by CWP and UWM were as shown in Fig. 3.5, ($p<0.05$). Although Mart in-Sanchez *et al*. [20], state that the use of alkaline saline solution during the washing increases the muscle pH providing greater solubilization and further elimination of the lipids. The lowered pH of dark fleshed fish during postmortem handling or storage, gradually decreases gel forming ability. Alkaline leaching has been developed to raise the pH of muscle and to increase the efficacy in removing sarcoplasmic proteins, lipid, pigments, etc. [27].

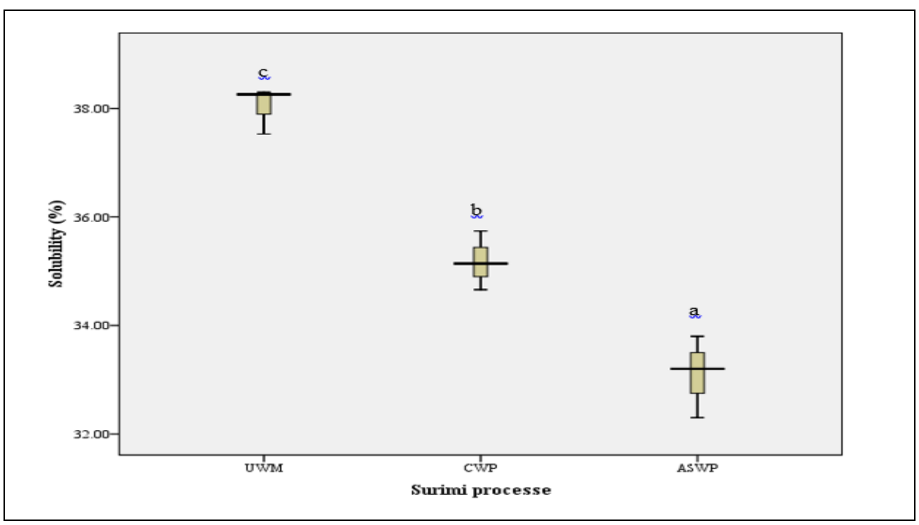


Note: a and b letters on the bars within the same washing treatment indicate the significant differences ($p< 0.05$).

Fig. 3.5 pH of surimi prepared from Lesser sardine unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP).

3.6 Solubility of gels prepared from unwashed mince and surimi prepared by different washing processes

Solubility was reported to be 38.0, 35.18 and 33.10% in the UNW, CWPS and AWPS, respectively (Fig. 3.6). The decrease in solubility suggests the formation of protein aggregates during setting and heating [2].Generally washing process removes sarcoplasmic protein. A reduction of 27.77% in total protein was observed after washing which is mainly contributed by water soluble protein (WSP) reported by [31]. Roussle and Cheffel [26] observed a protein loss 21.27% in European sardine, while Bligh *et al*.[7], Gratnthum [15] found the loss of protein to the extent of 25% due to washing. The loss of myofibrillar proteins during surimi processing could be due to the nature of their water solubility. Wu [32], Stefansson and Hult in [29] reported that myofibrillar proteins solubilize in water and low ionic strength solutions.



Note: a, b, and c letters on the bars within the same washing treatment indicate the significant differences ($P<0.05$).

Fig. 3.6 Solubility of surimi prepared from Lesser sardine unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP).

3.7 Organoleptic evaluation of unwashed mince and surimi prepared by different washing processes

Organoleptic evaluation of Lesser sardine surimi gels of unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP) was evaluated for colour, appearance, odour, taste, texture and overall. A nine-point hedonic scale, in which a score of 1 = not like very much, 5 = neither like nor dislike and 9 = like extremely, was used for evaluation [21]. ASWP had higher score for overall acceptability as compared to other washing processes as shown in Fig. 3.7. [22] observed that sensory characteristics of mince improved by washing. Twice-washed surimi samples showed better sensory quality than the single wash.

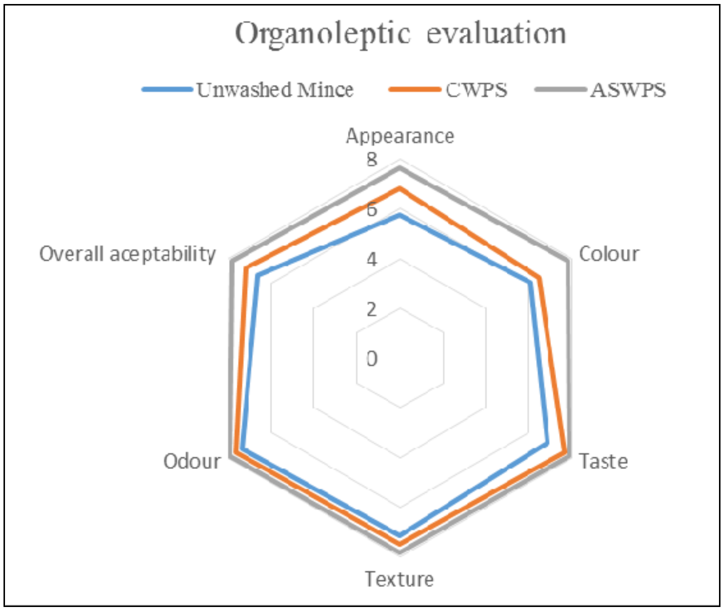


Fig 3.7: Organoleptic evaluation of surimi prepared from Lesser sardine unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP).

4. Conclusion

Variation in gel strength was observed in unwashed mince (UWM), conventional washing process (CWP) and alkaline-saline washing process (ASWP). However, ASWP showed the highest gel strength followed by CWP and UWM. ASWP were found to have better gel strength, whiteness and over all acceptability as compared to other treatments. Therefore, it can be concluded that ASWP washing processes of surimiis ideal process for obtaining a good quality surimi from the Lesser sardine (*Sardinella* spp.).

5. Acknowledgments

The authors are thankful to Hon'ble Vice Chancellor, all university authorities of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India and Associate Dean, College of Fisheries, Shirgaon, Ratnagiri for their encouragement and providing necessary facilities for the present work.

6. References

1. Alvarez-Parrilla E, Puig A, Lluch MA. Preparation and chemical and microstructural characterization of surimi from hake (*Merluccius merluccius*) and horse mackerel (*Trachurus trachurus*). Food Science and Technology International. 1997; 3(1):49-60.
2. Balange A, Benjakul S. Enhancement of gel strength of bigeye snapper (*Priacanthustayenus*) surimi using oxidized phenolic compounds. Food Chemistry. 2009a; 113:61-70.
3. Balange A, Benjakul S. Effect of oxidised tannic acid on the gel properties of mackerel (*Rastrelligerkanagurta*) mince and surimi prepared by different washing processes. Food Hydrocolloids. 2009b; 23:1693-1701.
4. Balange AK, Benjakul S. Use of kiam wood extract as gel enhancer for mackerel (*Rastrelligerkanagurta*) surimi. International Journal Food Science Technology., 2009c; 44:1661-1669.
5. Belibagli KB, Speers RA, Paulson AT. Thermo physical properties of silver hake and mackerel surimi at cooking temperatures. Journal of Food Engineering. 2003; 60(4):439-448.
6. Benjakul S, Visessanguan W. Transglutaminase-mediated setting in bigeye snapper surimi.Food Research International. 2003; 36:253-266.
7. Bligh EG, Dyer WJ, Reiger LW, Dingli IR, Legenda R. Function and nutritive food from fish. *Paper E 25, FAO Technology Conference.* On Fishery Products. Tokyo, Japan, 1973.
8. Bradford MM. A rapid and sensitive method for the quantitation of micro-gram quantities of protein utilizing the principle of protein-dye binding. Anal Bio-chemistry. 1976; 72:248-254.
9. Chaijan M, Benjakul S, Visessanguan W, Faustman C. Characteristics and gel properties of muscles from sardine (*Sardinella gibbosa*) and mackerel (*Rastrelligerkanagurta*) caught in Thailand. Food ResearchInternational. 2004; 37(10):1021-1030.
10. Chawla SP, Venugopal V, Nair PM. Gelation of proteins from washed muscle of threadfin bream (*Nemipterus japonicus*) under mild acidic conditions. Journal. of Food Science. 1996; 61(2):362-367.
11. Chen HH. Decolouration and gel-forming ability of horse mackerel mince by air-flotation washing. Journal. of Food Science. 2002; 67:2970-2975
12. Das N, Khuntia BK, Raychaudhuri U, Dora KC, Ganguly S. Effect of Water Washing on the Functional Properties of Fish Meat. International Journal of Medical Microbiol. and Tropical Diseases. 2015; (1):8-12.
13. Fogaça FHS, Dtani FS, Portella CD, Santos-Filho LGA, Sant'Ana LS. Caracterization surimi obtido a partir da carne mecanicamente separada de til ápia do Nilo e elaboração de fishburger. Semina: Ciências Agrárias. 2015; 36(2):765-776.
14. Grantham GJ. Minced fish technology: A review. FAO

Fish. Tech. FAO United Nations. Rome, 1981; 72:216.

15. Hall GM, Ahmad NH. Surimi and fish-mince products. In: Fish processing technology, Springer, US, 1997, 74-92.
16. Hassan MA, Balange AK, Senapati SR, Martin Xavier KA. Effect of Different Washing Cycles on the Quality of *Pangasiushypophthalmus* Surimi. Fishery Technology. 2017; 54:51-59.
17. Lanier TC. Functional properties of surimi. Food Technology. 1986; 40(3):107-114.
18. Lee CM. Surimi process technology. Food Technology. 1984; 38(11):69-80
19. Mart ín-Sánchez AM, Navarro C, Pérez-Álvarez JA, Kuri V. Alternatives for efficient and sustainable production of surimi: a review. Comprehensive Reviews in Food Science and Food Safety. 2009; 8(4):359.
20. Meilgaard MC, Carr BT, Civille GV. Sensory evaluation techniques. CRC press, 2006.
21. Ninan G, Bindu J, Joseph J. Properties of washed mince (surimi) from fresh and chill stored black tilapia, *Oreochromismossambicus* (Peters: 1852). Fisheries Technology. 2004; 41(1):21-28
22. Pagarkar AU, Joshi VR, Baug TE, Kedar JG. Value addition is need of seafood industries. Fishcoops Delhi, 2011, 8-12.
23. Pagarkar AU, Shaikh SM, Aware VV, Shirsat NA, Patil SV. Studies on performance of finger coats, medical gloves and surgical gloves on women workers for fish dressing operation in seafood processing Industries. Ecology Environment and Conservation. 2014; 20:S429-S433.
24. Rahman MS, Al-Waili H, Guizan N, Kasapis S. Instrumental-sensory evaluation of texture for fish sausage and its storage stability. Fisheries science. 2007; 73:1166-1176.
25. Roussel H, Cheffel JC. Mechanism of gelation of sardine proteins: influence of thermal processing and of carious additives on the texture and protein solubility of Kamaboko gels. Intentional. Journal. Food Science. and Technology. 1990; 25:260-280.
26. Shimizu Y. Manufacturing method of leached meat. Japanese Patent, Showa 1965; 40:21224.
27. Shimizu Y, Machida R, Kawasaki M, Kaguri A. Characteristics in gel forming property of abundant dark-fleshed fish. General report of the studies of effective utilisation of abundant dark fleshed fish species. Japan: Fisheries Agency, 1979, 93-102.
28. Stefansson G, Hultin HO. On the solubility of cod muscle in water. Journal. Agriculture. Food Chemistry. 1994; 42:2656-2664.
29. Suzuki T. Fish and Krill Protein: processing technology. Applied Science Publishers, London, 1981, 46-52.
30. Tiwari SN. Functional and rheological properties of proteins from Fish (Sardinella longicep) effect of physical and chemical treatments. M.F. Sc. thesis submitted to the U.A.S., Bangalore, 1995.
31. Wu YJ, Atallah MT, Hultin HO. The proteins of washed, minced fish muscle have significant solubility in water. Journal Food Biochemistry. 1991; 15:209-218.