12. DISCUSSION

12.1 Snail soup powder : A ready to cook value added product

Value-addition is the process of taking a raw commodity (some time it may carry less economical importance) and changing its form to produce a high quality product (towards significant economical up liftmen). The process of preparation of this snail soup powder was done by adopting simple methodology, as far as possible. With the viewpoint that any people or any group of people can adopt this technique (mainly for commercialization) by investing little amount of effort. Here snail soup power indicated less time-consuming preparation, which can provide required amount of nutrient to consumer.

12.2 Six months shelf-life assessment during storage in the room temperature

From the biochemical point of view, protein percentage in soup powder was 58.53 % (at initial stage) after six months it became 51.33 %. This percentage of protein value (through out the 6 months of storage period) comply about the requirements of protein to all aged people (from a child to adult) (Chakraborty, Mukherjee and Maity, 2015) as per WHO's (2007) recommended guide line. This reduction in the amount of protein (7.2 %) was due to somewhat denaturation of soup powder itself during storage condition (Gopakumar,2002). Based on Ackman (1994) classification the crude lipid content in soup powder, was in acceptable limit, which indicated presence of medium lipid level in the snail soup powder (Table 19). But regarding the six months of storage condition (at ambient temperature) the percentage of crude lipid level was indicating its reduction trend due to enzymatic degredation (Shewfelt,1981 and Ashton, 2002). Same

observation was found in the case of health mix powder, derived from the fishery product (Saritha and Patterson, 2014).Similar trend was observed in case of Carbohydrate also.

Moisture content is a precise pointer of the susceptibility of a product to undergo the microbial spoilage. Moisture also affects the stability and shelf-life of the food product which was essential to control regarding the inhibition growth of the microorganisms. Moisture content below 10% level was good for microbial safety of the preserved fishery products as well as it had a potential effect on the chemical reaction rate and microbial growth rate of the food product (Labuze, 1970). Moisture content in the snail soup powder (Table 19) (Fig.19) was low (2.10±0.18) and varied ($p<0.05$) between 2.10±0.18 and 3.93±0.42 % during six months of storage period at ambient temperature. Nevertheless, it was not exceed the acceptable level. Several authors (Vanugopalan, 1969, Gopal *et. al*.1988, Chacko 2005, Rathod 2013, Saritha and Patterson, 2014) noticed similar increasing trend in moisture content at the storage period of several kinds of fishery product.

The assessment of pH value for any value added product is a good index and an important determining factor for quality assurance. In this present study soup powder reported slightly increased pH from 5.36±0.68 to 6.27±0.39 during six months of storage period (Table 20) (Fig. 20). This increased level of pH value may be caused due to the enzymatic degradation (Love, 1992 and Vareltzis *et.al.,* 1997) in this snail soup powder. Almost similar result was noticed for other preserved fishery products (Chacko *et. al.*, 2005, Pawar 2011, Rathod, 2013).

The FFA (% oleic acid) content is an indication of lipid hydrolysis. As the freshness quality of fish gets reduced, the FFA content in the lipids of stored fishery

products increases due to the action of lipases (Reddy *et. al.* 2012). In this present study percentage of FFA (% oleic acid) slightly increased from the initial value 0.26±0.59 to 0.62±0.76 % oleic acid. Almost similar FFA value (% oleic acid) was observed in squid soup powder (Chacko *et. al.*, 2005).FFA formation was found to be inhibited by heating and it might be due to the hydrolysis of lipids by phospholipids (Kaneniwa,2000). Initial processing by heating and drying process presumably inhibited enzymatic lipolysis of any fishery product. Rancidity developments due to primary lipid oxidation was known to be a major problem in the storage products but in our study, lipid contain was already pressed out. As a result, oxidative and hydrolytic rancidity can be inhabited during the six months of storage period (Table 20) (Fig. 21).

Total volatile base-Nitrogen is a commonly used chemical method to determine spoilage of any edible stored biological product. The TVB-N in freshwater originated animals and their products was known to come from ammonia. Both TMA-N and TVB-N was produced from degradation of proteins and non protein nitrogenous compounds mainly as a result of microbial activity (Connell, 1975).The spoilage indicators like TMA-N and TVB-N presented their increasing trend in the study but they were remain within the acceptable limit (Table 20) (Fig. 22 to 23) i.e.10-15 mg N/100 g and 35-40 mg N /100 g for TMA-N and TVB-N respectively, (Lakshmanan.,2000). The changes in total plate count of the soup powder were mentioned in Table 20. The total plate count of the soup powder was low in the initial period but it was gradually increased during the storage period. The acceptable limit for total bacterial count was reported within the limit of 10^3 to 10^6 (Lakshmanan.,2000).And this study results kept the microbial count within the acceptable limit (Table 20). Pathogen such as *E. coli* and *Salmonella* spp were not

detected. Vanugopalan and James (1969) reported that the "Total Heterotrophic Bacteria" (THB) of soup powder was safe according to limits. When compared with the tolerance limit it became safe for human consumption. Additionally it can be mentioned that decrease of the THB during storage may be due to the use of preservatives as well as condiments *viz.* onion, garlic and black pepper etc (Chacko,2005). It was also reported by Kumar and Gupta (1984) that addition of condiments reduces the chances of growth of *Staphylococcus aureus*.

The sensory evaluation of the soup powder was indicated in (Table 20) (Fig.24). The soup powder indicated its good colour, with a characteristic flavour. The sensory score obtained was good and no remarkable changes in colour, flavour, texture, taste and other characteristics were observed till the end of the six months of storage period. The mean panel scores for all the sensory characteristics remained within the acceptable limit throughout the storage period. The product had a maximum score on the 2nd month (in storing condition) and a gradual reduction in score was observed till the end of the six months storage period.

12.3 Significance of snail soup powder from the industrial point of view, which may generate a novel idea towards the socio-economic augmentation

Therefore, this estimated value referred that snail soup powder can be regarded as a nutritious health drink which can be served among the 5 to 80 years of people. Its moisture content ranging from 2.10±0.18 % to 3.93±0.42%, referred that this soup powder was a dry, almost moisture less product which referred to have a great life span (shelf-life) and less susceptible for degradation. In addition, it was confirm, this soup powder can be kept, up to six months in ambient temperature (room temperature) at proper packaged condition.

Beside the biological importance, this snail soup powder has other significant role from socio-economic point of view. It was previously stated that, in West Bengal commercial utilization of *Bellamya bengalensis* was noticed mainly in its south-western part of West Bengal. Here many rural people were observed to take this profession as their main source of livelihood. Some of them were noticed belonging below the poverty line.

This snail marketing was reported to have seasonal characteristics. Because in the winter season (November to February), the availability of *B. bengalensis* became scare, which hampered the marketing activities. For this reason, by encompassing this profession people often was observed to face, a fluctuation in monthly income. In this period of time those people involved in agricultural and others activities (Chakraborty,Mukherjee and Maity,2014a).

Therefore, if commercialisation of this snail soup powder can be started from this rural people of the stated regions, a real economical uplift may be initiated. Where peoples can earn their steady income also. Not only that this snail soup powder can also provide several beneficial opportunities towards the commercialisation, such as:

- Increase the per annum earnings of the people who engage with the marketing of *B.bengalensis*.
- Stabilize income by allowing, income creation during off-seasons, when availability of *B.bengalensis* becomes low.
- Creating an opportunities to sell this snail soup powder and other different value added product of *B. bengalensis,* to the tourists who usually came from different states or country.

- Provide opportunities for other groups or sectors of people to create income (employment) by encompassing these business activities.
- By utilizing this business activities several ancillary business sectors (small or large scale) can be developed, which indicating about the economical growth of an area or a society .
- Provide an outlet for other creative talents.
- Making use of excess produce, so that each unit of the product can be sold at a higher price and achieves a higher return.
- For household practices, making own soups can provide economic orientations also.

However, edible value addition of *B.bengalensis* has not yet been initiated in West Bengal as well as in India. But by using garden snail (*Pomacea haustrum*, *P. caniculeta*) and apple snail (*Pila ampullacea*) different kinds of edible value added products such as snail fry, snail spicy items, snail croquettes, snail salad etc were known to manufacture in Vietnam, China, Japan etc.

Although, it was noticed, on this shell fish sector, slow emphasis was being given (Patterson, 2004). After proper value addition with this snail (development of various ready to eat food products, handmade product, pharmaceutical and medicinal products etc), it can be possible to open the door of creation a small scale or large scale industries. Furthermore, if this process can be started through this rural fishermen as well as poor people, a real rural socio economic development can be possible.