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Meat demand - Snailed it: A comprehensive review on snail rearing, to meet the meat demand in future India

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Abstract

Snail rearing has flair to encounter the meat requirement of inflating human population, owing to its high nutritive value. This review canvasses about the potential of snail farming, its benefits & challenges, nutritional aspects, management and importance in reinforcing the economy and livelihood, especially of low income farmers. Keeping in view the time ahead demands of animal meat in Indian market, future possibilities and recommendations are also discussed in this review.

Keywords: Snail rearing, heliculture, snail farming, animal meat

Introduction

Food security in future is a serious situation, and one of the biggest concerns is that the protein demands might beat the protein supplies, lead to the nutritional deficiencies and health issues (Müller and Krawinkel, 2005) ^[29]. To avoid this alarming situation an alternate, earlier the better, is needed to be identified, a substitute to the protein source, of animal origin. In present situation it is both reasonable, and sensible to give pay attention towards nutritional security rather than food security, because along with the amount of food, the quality of the nutrients it contains also matters (Ghosh *et al.* 2016) ^[21]. Therefore, it is oblivious to strengthen the livestock sector, whether its cattle/ poultry or fisheries, to recoup the nutritional requirement of growing population, as nutritionally animal protein has a higher value than that of plants because of larger quantity of essential amino acids and micronutrients. This makes the animal-based food stuffs best course to alleviate the protein malnutrition prevalent throughout the developing world, including India (Neumann *et al.* 2002) ^[32]. In view of that, for compensating the demand of animal protein, in terms of choice and variability, snail protein is a potential option. Gastropods, therefore, are the source of nutrition comparable to or even superior to conventional livestock (Ghosh *et al.* 2016) ^[21].

Snail Rearing

“Snail is frail but does not fail to assail every nail on its trail” -Weighty 'n' Worthy African Proverbs, by Vincent Okay Nwachukwu

Snail farming (Heliculture/ Heliculture), is method of culturing land snails for human use, either direct consumption as food (edible escargot or snail egg as caviar) in medication, or in cosmetics, suing snail slime. Snail is a terrestrial shell bearing animal of approximately 100,000 species of Molluscs, of the Phylum Mollusca, or alternately, any of the twelve species of land pulmonate gastropods used as human food (Akinnusi, 1997, 2000) ^[5, 6]. Being a source of nourishment and nutriment since a long time in African communities (Meyer-Rochow, 2009) ^[28], snails are now becoming a highly relished delicacy and has been recognised as ‘Congo meat’ (Fagbuaro *et al.* 2006) ^[20]. The snail is usually found in damp places, under leaves, tree stumps and stones (Amusan *et al.* 1999) ^[7]. They are abundant in the raining season, but undergo aestivation and hibernation, during the dry season, by forming a membrane over the shell opening, to reduce water loss. Amusan *et al.* 1999 ^[7], further indicated that snails are well adapted to adverse environmental conditions, such as cold, heat and temperature fluctuation and they have natural immunity against disease causing organisms, such as *Streptococcus*, *Staphylococcus* and *Penicillin* species (Hamzat, 2003) ^[23]. Despite the many accepted benefits of having snails as an animal protein source, snail rearing still has not gained the popularity it deserves.

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Snail farming could be used as a potential tool as meat protein source, and could play a pivotal role in livelihood development in forest dependent communities (Ndah *et al.* 2017) [31]. Although many snail species are in consumption as food or medicinal purpose, reliable data concerning their rates of consumption, seasonal availability and species specific nutritional profile is still lacking (Bonnemain, 2005) [10]. Consequently, to overcome the obstacle of protein shortage and alleviate the effects of the present global food crisis, snail domestication should be given more attention in terms of funding and research (Babatunde *et al.* 2019) [8]. This paper aims to review the nutritional benefits, domestication & maintenance of snail rearing and also intent to justify the need to introduce snails as meat protein in Indian diet system where insect meat receives less recognition as compared to already prevalent conventional meat food *viz.* Mutton, chicken, beef or fish.

Nutritional Point of View

In comparison to plant protein, animal protein holds higher nutritional status, owing to larger amount of essential amino acids in the later (Yen, 2009) [36]. In African culture, there is a tradition to use snail meat in preparation of concoctions due to its medicinal value, especially in case of labour pain and prevention of blood loss at the time of delivery (Cooper and Knowler, 1991) [16]. Bright in 1999 [12] pointed out that snail meat is good for hypertensive people, and act as antidote in people with fat related issues. Over the past few years, there is a boom in demand of snail meat by virtue of high nutritive value, medicinal importance and aesthetic values (Cobbinah *et al.* 2008, Etchu *et al.* 2008) [14, 19]. Ademolu *et al.*, 2004 [1] and Etchu *et al.* 2008 [19] reported that Snail meat possess a fair amount of iron and is also cholesterol free, this has made it as delicacy in many part of world like Cameroon and France, and due to its palatability has become a choice in diet, among the meat eaters.

In *P. canaliculata* meat, USFA reported to be 60.5% and SFA as 39.5%. Among unsaturated fatty acids, oleic acid and linoleic acid were in higher amount as compared to other fatty acids. In saturated fatty acid content of palmitic acid is maximum followed by stearic acid. This makes the snail fat of good dietetic standards. Similarly, among minerals Ca is the most abundant of all, followed by P, Fe and Zn (Ghosh *et al.* 2017) [22].

Domestication and Management

Snail rearing is practiced in open field conditions and under controlled environment like net-covered pens. Advanced methods for culturing snails have been developed in many countries like Italy, Spain and France (Elmslie 1989, Iglesias *et al.* 1996) [18, 25]. Though the practice of rearing the snails could be performed in closed farms, which lead to higher production, but extra care is required to protect the snails from the attack of predators. Commonly, hand picking is performed from damp areas like swamps and ponds and flooded fields during rains and monsoon. In summers, because of high temperature in environment and low humidity, snails hide themselves under soil and dry mud (Setalaphruk and Price, 2007) [33].

Snail has wide range of feeding habit and therefore can gain an appreciable weight, under proper management conditions, thus can surpass conventional meat animals in terms of productivity. This makes snail rearing a cheap and less labour intensive practice, and farmer can earn high returns from low

inputs (Adeyeye in 1996) [2]. The snails were fed with green leaves, fruits, tubers or even kitchen waste (salt and oil containing food waste should be avoided, which attracts predators). The fruits which were commonly given were mangoes, avocado, and bananas and for the tubers they were given cassavas and sweet potatoes. The baby snails at the early stages are mostly fed with juicy food substance. Regular feeding and cleaning of the pens is required (Ndah *et al.* 2017) [31]. Humidity and temperature are primary factors of concern in snail farming as these organisms are very sensitive to their environment and breeding them is even more difficult task. Vinci *et al.* 1988 [35], for instance, reported that *Achatina fulica*, requires a temperature of 22-32 °C and relative humidity more than 85%, as optimum conditions for mating. Some other factors also need to take in consideration, most important of which is the snail's stage of development and habit. Snail pens/ boxes could be constructed in a dimension of 2 x 0.6 m and must be placed at least 1m above the ground. Plastic covering of the pens will allow free circulation of air and also provide protection in heavy rains. Various kinds of snailery could be made *viz.* hutch boxes, paddock pens, movable pens, trench boxes etc. The pens could be separated into compartments, for mature snails in one compartment and baby snails in the other (Ndah *et al.* 2017) [3]. Pens/ boxes must be escape proof and also protect snails' culture from attack of predators. Material used in making the pens must possess quality to resist termite and other decay due to harsh weather conditions. Organic matter rich soil, with a thickness of about 4 cm, should be placed at the bottom of the pens and the box floor, which facilitate digging & egg laying (Ndah *et al.* 2017) [3].

Common practice is, direct picking and harvesting of snails from their wild environment and this practice can have ecological consequences due to mass extinction of the species. Therefore, establishment of snail farms become much important to prevent the extinction threat to these organisms, moreover when there is little investment in terms of labour and capital and more returns in terms of food and income. Further, establishment of such farms back up in solving nutritional shortcomings and unemployment in countries with poor income (Ghosh *et al.* 2017) [22].

Indian perspective

India is home to a wide variety of dietary systems that vary with state and religion. Apart from in vogue animal protein diet like fish, mutton, beef, and chicken etc., non-conventional sources for the meat protein sources should be explored and introduced to the food menu. Regions of the country where snail meat is consumed as meat may cause a threat to biodiversity as; in these cases snails are harvested from their natural habit and wild conditions instead of farming (Ghosh *et al.* 2016) [21]. Snail consumption in food and diet is restricted to some areas of north east India and West Bengal, in such regions freshwater life forms like fishes, and molluscs plays an important role in livelihood and economy (Borkakati *et al.* 2009) [11]. To name a few well known and edible species are *Anisus convexiusculus*, *Bellamya bengalensis*, *Lamellidens marginalis*, *Melania tuberculata* and *Pila globosa* (Baby *et al.* 2010) [9]. Some other species as mentioned by Ghosh *et al.* 2016 are *Achatina achatina*, *A. fulica*, *Archachatina marginata*, *Cornu aspersum*, *Limicolaria sp.* *Lanistes varicus* etc. This indicates that, though snail farming is not a new concept in field of meat production from animal husbandry, it still lags from

being widely accepted as mainstream practice.

Iheke and Nwankwo, 2016^[26] gave recommendation that, youths must be encouraged to adopt this practice; it will not only provide a source of income but also a regular means of livelihood too. Economic analysis showed that marketers require a working capital to start the snail farming because supply of snails is irregular and the business is funded from personal savings and support from cooperative society. To upgrade this condition, marketers should be empowered with low interest loan and advocacy on Snail farming should be encouraged to ensure conservation to prevent extinction (Babatunde *et al.* 2019)^[8].

Rewards in Snail Rearing

1. Snail meat act as neutralizer and antidote in people suffering from hypertension and other vascular diseases like heart attack (Iheke and Nwankwo, 2016)^[26], owing to low cholesterol and high PUFA
2. Chemical substances from snail meat are reported to cause bacterial agglutination, and are therefore, used again bacterial ailments like whooping cough (Cobbinah, 1993)^[15].
3. Snail shells also have aesthetic values and used in making key chains, buttons and other jewelleryes. Also have explicabilities in wall decoration and other ornamentations (Iheke and Nwankwo, 2016)^[26]
4. Snails have high fecundity, and survival (Akinbile, 2000)^[4] and thus sufficient meat for the meat consumers
5. The special adaptability found in snails in their natural habitat accounts for very low mortality rate, compared to other conventional livestock (Hamzat, 2003)^[23].
6. Installing and maintaining a Snail farm would require less capital as compared to other livestock farming system, therefore, a less income farmer could comfortably embark on Heliculture.
7. Snail rearing has potential to meet employment demands i.e. job creation and therefore can impart social and economic benefits too (Akinnusi 1997)^[5]. This will boost stand of living and also farmers' purchasing power (Hooker, 1864)^[24].
8. Snail domestication does not require any special skill and education, and basic knowledge for snail rearing could be given by extension programmes by Government and private agencies. There is therefore the need to examine its feasibility for empowerment and maximization of marketing efficiency (Babatunde *et al.* 2019)^[8].

Challenges in Snail farming

1. Dry season is one of the biggest challenges in domestication of snails when soils are dry, moisture is less and food availability is an issue. This may cause desiccation and death, and thus reduces the population of snails in pens. Therefore, special care of moisture maintenance is needed.
2. Special vigilance required to prevent attack of predators.
3. Furthermore, snails feed heavily and growth very fast, for this reason regular feeding needs to be maintained.
4. Negligence in providing optimal conditions while snail rearing may lead to mortality, reason could be nutrient deficiencies, predators, parasites or other causes. Though concrete evidence, as published information, is not plentiful (Cooper and Knowler, 1991)^[16].

Risks and Uncertainties involved in Snail farming

1. Increasing demand in snail has caused an ecological threat to natural snail population due to indiscriminate hunting for food and other business prospects, causing survival pressure to the species.
2. Special care is needed in preparation of snail meat for consumption purpose, as raw or undercooked meat is reported to cause infections like angiostrongyliasis (Tsai *et al.* 2001 Lv *et al.* 2009)^[34, 27]. Therefore, its recommended to remove gut content from the snails' body by starvation or feeding wheat bran for few days before consumption as food (Ghosh *et al.* 2016)^[21].

Discussion

To confront dearth of food, especially in terms of animal meat, snail farming could be of assistance. Ghosh *et al.* 2016^[21], recommended that awareness must be created regarding nutritional benefits and economic satisfaction involved in snail farming, particularly among small land holders or enterprises. Snail rearing should be promoted to meet the snail demand during dry seasons and to maintain a natural population balance of the species, also people should be enlightened about its nutritional and medicinal benefits (Christian *et al.* 2019)^[13], this will cause market expansion. Many research institutions of the country are already promoting the farming methods for fish and mollusc rearing, it is important to bring this scientific approach among common people especially, low income farmer. Extension service could be of great help in dissemination this scientific know-how through media, pamphlets, articles, direct interaction with the farmers and radio talks (Ghosh *et al.* 2016)^[21]. Along with these training programmes must be organised by field experts and subject experts to inculcate the interested farmers regarding the snail farming methods and its benefits, chiefly when there is a market potential for the same. Unemployed and job seeking youth must be encouraged by NGOs/ government agencies to adopt snail farming and assistance must be provided with small loans and credits. Special subsidies must be introduced by the Government, to encourage more farmers to adopt snail farming as a full time business. Further, efforts should be made by authorities to discourage rural-urban migration by creating awareness that snail rearing is profitable business, owing to its less labour cost and higher net profits and overall margins (Munonye and Moses, 2019)^[30]. Proper infrastructure, planning, processing units and market are also required. Farmers should be encouraged to adopt snail farming where soil and climate conditions are favourable for rearing, even if snail consumption for meat purpose is not much prevalent (Ghosh *et al.* 2016)^[21]. Aiyeloja and Ogunjinmi, in 2010^[3] analysed BC ratio and rate of return and observed that snail rearing is both a profitable business and viable enterprise.

Conclusion

To compensate the future meat demand, snail farming should be encouraged and must be integrated with on-going farming system and animal husbandry, along with conventional meat venture (Ebenebe, 2000)^[17]. Introduction regarding nutritional benefits of mini livestock must be introduced in educational system, to broaden the acceptability in social infrastructure (Ghosh *et al.* 2016)^[21]. This could be facilitated by role of extension workers and subject specialist, by promotion rearing techniques and encouraging acceptability of snail meat in regular diets.

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