CHAPTER-I

Introduction

1.1 Introduction

Study of nutritional qualities of small fishes is an important aspect in context with life food security. Fish is one of the important sources of animal protein and also many nutrients which are essentially required in human diets (Fawolee et al., 2007). Fishes are consumed by large number of population throughout the world. Fish tissues contain fats, proteins, vitamins, minerals and many other vital components of balanced diet (Stancheva et al., 2010). Vital nutritional components of human body are provided by the fish food. Fishes play the key role of energy supplement for the human beings (Ojewola 2006; Suthershiny 2011). Fish proteins are easily digestible and stated to be the supplement of the protein needs of human body (Abdul et al., 2012). Nutritionists recommend that people should include fish in their daily diets (Blanchet et al., 2000; Balk 2004). Risks of life threatening diseases like cancer, dementia, Alzheimer's disease (Grant, 1997) are minimized by the regular consumption of fish. The defence mechanism for protection against invasion of human pathogens is increased by the intake of fish in human diet due to the presence of antimicrobial peptides (Ravichandran et al., 2010). Breast feeding mothers who consume fish regularly are blessed with babies having better eyesight. It may be due to the omega-3 fatty acids transmitted to breast milk. Fish foods prevent the cardiovascular diseases (Cahu et al., 2004). Fishes are enriched in vitamins and minerals equally required for both young and old age people (Edem 2009; Meghadedan et al., 2007). Fishes show an excellent role in the prevention of kwashiorkor and marasmus, a chronic disease originated by the protein-calorie malnutrition (Mahanty et al., 2012). Many of researchers studied that fish oil contain high amount of poly unsaturated fatty acids that are essential in lowering the serum cholesterol for the prevention of coronary heart diseases (Nordov et al.,2001; Turkmen et al.,2005).Many researchers concluded that fish oil may be used in the treatment of dis-lipidemia in diabetes. Consumption of fish during pregnancy plays

the role of reducing the risk of delivering premature baby (Olsen & Secher, 2002). Fish food is enriched in good quality and highly digestible proteins made of ten essential amino acids in required quantities for human consumption. It had been scientifically inferred by many studies that fishes contain important omega-3 fatty acids ,vitamins A,B,D&E and also many vital minerals like iron, copper, iodine, calcium, zinc, potassium, phosphorus which are essential food supplements for adults as well as infants (Ackman et al.,1988; Huss,1988; Owaga et al., 2010;Salito et al.,1997). Fish industries might be assumed to contribute positively towards the prevention of food insecurity if they are scientifically developed (Owaga et al.,2010).

According to (CSIR, 1962) fish flesh contains upto 15-25% protein, 80% water,1-2% mineral matter. As per (FAO, 1991) report it was established that fish contains 72% water,19%protein & 5% calcium . In amounting the weight of food consumed, fish stands in the third position after rice and vegetables (Minkin et al., 1997; Hels et al.,2002). Rice donot contain the nutrients like Vitamin A and C. The minerals such as iron, calcium, zinc and iodine are also not obtained from rice. These must be obtained from other sources. Small fishes are eaten whole with bones and heads ,the organs rich in calcium iron and zinc..The small indigenous fishes were investigated to be the key source of vitamin A (Thilsted et al., 1997). They show a great importance as a vital source of micronutrients as like as calcium, zinc, iron and fatty acids (Roos et al., 2003) to the rural poor people as well as an opportunity for livinghood of many fishers. Nutritional and medicinal knowledge about these fishes are traditionally high amongst the villagers. Such species are considered as very important part of the diet for a pregnant lady or lactating mother in the rural area. The scientific information about the small fishes is most essential for quality control purposes in the processing industries (Ray et al., 2014). Fishes are not only used as food but also highly demanded for use as feed (Daniel et al., 2015). Fish meat is found to contain low lipid and high water as compared to the beef or chicken (Nestel et al., 2000). Fish lipids are prime source of long chain polyunsaturated fatty acids which cannot be synthesized by human body (Alasalvar et al., 2012) . These polyunsaturated fatty acids are reported to be effective in the prevention of arterial hypertension, cancers and inflammatory diseases (Turkmen et al., 2005). The analysis of biochemical composition of the freshwater fishes is very important for the nutritionists. They are in search of most abundant sources of foods of low cost and containing high protein as the fresh species of small fishes (Mozaffarian et al., 2003; Foran et al., 2005). The proper estimation of nutrients contained in the fishes are of high interest to the food scientists who undergo researches in developing them into high grade animal protein ensuring the best quality flavor, colour, odour, texture and safety obtainable with maximum nutritive value (Elagba et

al.,2010). Proximate composition is the analysis of water, ash, protein and fat contents of fish (Ali ,2012) . For centuries, fishes are recognized as a perfect diet for human being because of having higher contents of unsaturated fatty acids, essential amino acids and important minerals for the formation of functional and structural proteins (Kumar, 1992) . Most of the essential nutrients for the high health status of human body are provided by fish (Andrew, 2001). In India fishes play a significant role for the livelihood baskets. Small indigenous fishes are very much enriched in nutrients. Previously these small fish species were overlooked for their low price and commercial unimportance. In present time, they receive good interests by the researchers and are included in planned farming as well. The small fishes are the source of protein and most of the fat soluble vitamins for the rural poor people (Hossain & Afsana, 1999).

The lacking in sufficient protein is the major nutritional deficiencies in many tropical countries (Eyo, 2001). Fish meat contains all of the essential amino acids. The protein content of fish have its importance in the qualitative analysis & texture of fish meat (Mozid , 2001).Fishes are energetic in the form of lipids. Good amount of polyunsaturated fatty acids in the fish oil help in reducing the serum cholesterol which prevent many coronary heart diseases. Generally marine fishes contain more minerals than fresh water fishes (Omotosho, 1995). The n-3 PUFAs are greatly used for neurodevelopment, brain functioning and eye health for the infants (Conner, 2000; Gokce, 2004). The fishes under the extensive and semi intensive conditions have higher nutritive values for human consumption in comparison to the ones found in the wild (Ahmed et al., 2012).

Fishes are one of the stable items in the diet of many people. India stands in the ninth position as the country of fresh water mega biodiversity (Mitterneier & Mittermeier, 1997). The northeastern region of India is declared to be one of the hotspots of fresh water fish biodiversity in the world (Kottelat & Whitten, 1996; Ramanujam et al., 2010). The state of Assam forms about 30% of the north east region and is enriched with Brahmaputra and Barak system with a number of tributaries.

Fish quality is measured by the nutritional excellence possessed by the fish (Kaiser et al., 2017). Fish have the energy gradient in the form of lipids. The amount of protein in fish muscle is generally 15 to 20 percent (Anusuya et al., 2014). Normally the nutritional values of a freshwater living fish detoriates when it is cooked with salt (Farid et al., 2016). A set of complex biochemical procedures occur during salt ripening of fishes and these

physicochemical changes evaluate the total sensory qualities of salted fish products (Farid et al., 2016). Fish feed makes about halves of the total cost of fish production (Craig et al., 2002). Sustainability of the industry of aquaculture mainly depends on the sources of feeds and management (Magondu et al., 2016). Besides the nutritional value, fish is an excellent source of income (Teame et al., 2016). Generally, the knowledge about the chemical composition of fish species is essential to the concerned nutritionists with easily available sources of low fat, high protein foods. In general, the composition of live-weight, whole fish is 70-80% water 20-30% protein and 2-12% lipid (Das & Sahu, 2001). Quantification of the proximate profiles of a fish ensures their ability to meet up the need of food regulations and commercial specification. The scientific documentation of biochemical composition is very important to calculate the energy value of the fish such that properly planning is done for the sake of industrial us well as commercial processing (Tsegay Teame et al., 2016). Fish are one of the cheapest sources of protein enriched with almost all the essential amino acids (Funmilayo, 2016). The amino acids are vitally needed for foctal development and growth. Dietary protein and the amino acids are required mainly for growth, metabolism and maintenance especially in young ones (Adefemi, 2011). The essential amino acids are the first indicator of protein quality (Chukwuemeka, 2008). The nutritional as well as medicinal status of fish products are highlighted by the contents of proteins, lipids, minerals and vitamins (Njinkoue et al., 2016). The fair contents of protein present in the fish flesh make them Biologically valuable (Salma et al., 2015). Being one of the potentially significant sources of health nutrients, fish is vitally important for diversified and healthy diets (Karl et al., 2016). For the rapid rise in population and environmental fluctuations, the aquatic lives are in crisis. As a result the gap between the demand and supply of fish is maximized. The poor people can not include the fishes in their regular food item (Mazumder et al, 2016). Generally, fish is low in saturated fats, carbohydrates and cholesterol.

Fish species are able to increase the biomass within a shorter time period. Rather than omega-3- fatty acids, fish lipids also contain fat soluble vitamins which are exclusively provided by the fish food. Omega-3 and Omega-6 fatty acids jointly play a vital role in the development of brain function and acceleration of the normal growth. Polyunsaturated fatty acids (PUFAs) enhance skin and hair growth, smoothens bone and reproductive health and help in regulating metabolism process (Stancheva et al., 2010) . The nutritive qualities of the fishes are known by the knowledge of its amino acid composition (Romharsha, 2014). Fish also contains a good bundle of lysine which is low in cereal, milk or any other foods (FAO, 2005). Fish food provides the important minerals including selenium, calcium, iron, phosphorus etc.

Fish makes up almost half of the total number of vertebrates in the world. India is one of the mega biodiversity countries in the world (Mittermeier & Mittermeir., 1997). The northeast part of India has been specified as a hotspot of biodiversity by the World Conservation Monitoring Centre (WCMC, 1998). The hills and the undulating valley of the northeast region creates many torrential hills streams leading to popular large rivers that constitute part of the Ganga-Brahmaputra-Barak-Chindwin-Kolodyne-Gomatie-Meghna system (Kar., 2003).The conservation Assessment and Management Plan Workshop (Molur & Walker, 1993) made valuable contributions to assess the status of selected fishes of northeast India. However no detailed systematic fish inventory has been available on the ichthyo fauna of Kokrajhar district BTAD, Assam.

Adverse effect of environment, climate changes, increasing water temperature (Parihar & Dubey, 1995) are declining the water level of different rivers, ponds and other water bodies (Dubey et al., 2011).Tremendous use of pesticides and xenobiotic compound (Dubey,1995) negatively fall on the fish communities. The fisheries productivities are affected by the city garbages and garlanding in the aquatic bodies. The number of fish species in the aquatic ecosystem is declined. Recently many new species have been documented from the states of northeast India (Sen & Biswas, 1994; Biswas, 1997; Menon, et al 2000; Vishwanath & Shanta., 2004) opening the scope for exploring on the nutritional qualities of the fishes. The fish food is included in the diet of almost all the communities of all religions of the country. The analysis of the quality of fish food will ensure the people about their food values and the required quantities of consumption of fish foods in different age groups. Although many more researches have been done on the nutritional status of fish foods, but less studies have been reported so far on the small fish species.

The present study mainly aimed at the study of the nutritional contents of the small fish species available in the Korkrajhar district BTAD, Assam. These fishes are commercially unexploited. The well known popular large fishes are mostly attractive to study and also to exploit from the commercial point of view. Due to their high price they are not affordable by the common people, specially the poor villagers. They consume the small fishes deliciously and also sail in market to maintain their livelihood.

The nutritional composition of fish varies largely from one species to another species depending on age, feed intake, sex and sexual changes connected with spawning the environment and season. Fish belongs to high protein and low lipid class. According to the

research studies fish foods contain low caloric content per unit of protein than do lipid and they provide the animal protein for use in contolled diets (Silva et al., 1991)

Small indigenous fish species are defined as these of having maximum length of 25cm (Felt et al., 1998; Roos et al., 2003). In many parts of the world including India, a large diversity of small fishes are found in open waters and closed water bodies. The small indigenous species are reachable to the poor and rural classes of the country due to their low price and maximum availability. Researchers suggest that these are major source of protein and micro-nutrients like calcium, zinc, iron and fatty acids (Roos et al., 2003). In many parts of our country basically amongst the rural societies, such species are often considered as essential part of the diet of pregnant woman and lactating mothers. Moreover the fish species also posses several antioxidant activity (Ray et al.,2014). The small fish species are thus excellent sources of nutrient and antioxidant. Fish flesh is easily digestible due to its long muscle fibres. Fish foods have been linked to health benefits like some types of cancer, including colon, breast and prostate (Marchioli et al., 2002; Sidhu et al., 2003).

1.2 Structure of fish muscle

Fish muscle is comprised of moisture, protein and fat as a major nutrient components and carbohydrates, vitamins and minerals as minor components. That is why most of the nutrient components essential for human body is found in fish muscle. Animal protein is associated with ten essential amino acids in desirable quantity for human consumption. Fish protein is enriched with such amino acid as methionine, lysine and low in tryptophan in comparison to mammalian protein (Nowsad, 2007).

The diagram of a cod fillet reveals the surface that is adjacent to the skeleton. The mechanical construction is typical of all white fish in which the fat is stored in the liver. The blocks of muscle forming the individual flakes in the cooked fish are separated by connective tissues.These are curved in the fillet running from the backbone to the skin. The muscle blocks in a fresh fish are tightly attached to the connective tissues and the surface of a cut fillet is finely smooth. There are also tiny blood vessels which run through the muscle .Out of the total weight of the muscle the connective tissue makes for only a small percentage .This may be the reason of why fish is softer to eat than meat.

There are two kinds of fish muscle , light muscle and dark muscle. In white fishes there is a small strip of dark or red muscle under the skin on both sides which run beneath the lateral

line .In fatty fishes the strips of dark muscles are larger in proportion containing higher concentrations of fats and vitamins. When fishes are prepared for cooking it is not usually possible to separate the dark fatty muscle from light muscle.

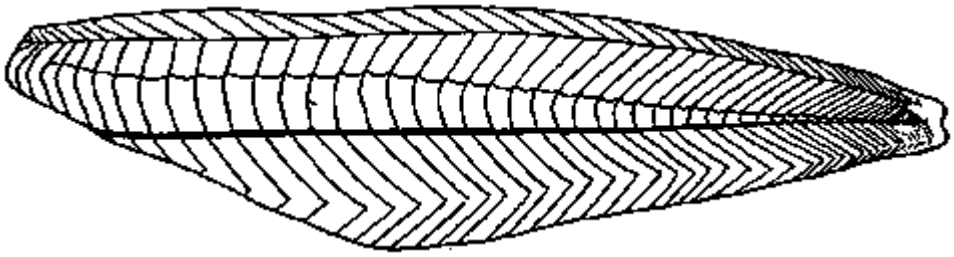

Fig.: 1.1 Fish muscle

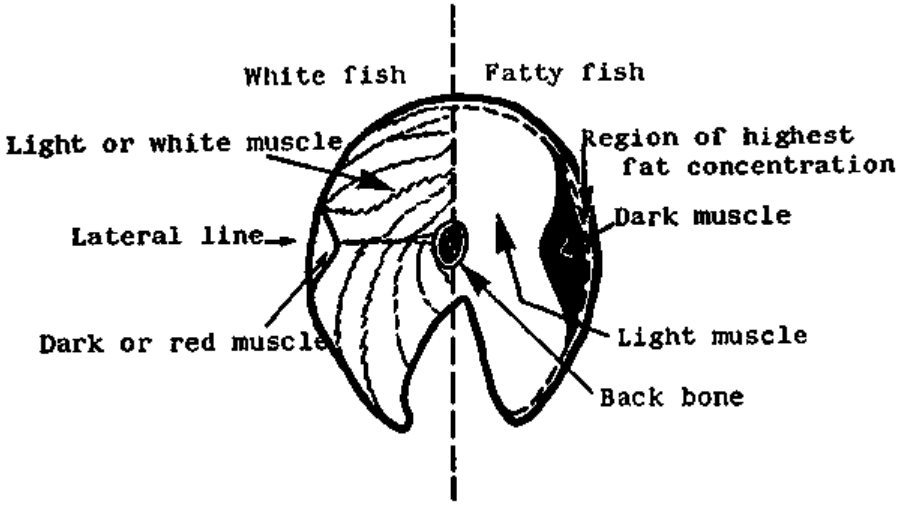

Fig. 1.2 White Fish muscle (FAO CORPORATE DOCUMENT REPOSITORY)

Fisheries especially provide food when other food sources are at a seasonal crisis (Babalola et al., 2011). Moreover, consumption of fish has been related to health benefits as the long chain PUFA is of great attention in the field of prevention of human coronary artery diseases, improvement of retina and brain development, decreased incidence of breast cancer, rheumatoid, arthritis, multiple sclerosis, asthma, psoriasis, inflammatory bowel disease and regulation of prostaglandin synthesis (Dhaneesh et al., 2012). Recent studies have shown that fish protein is said to be of excellent quality with a higher biological value. Fishes play a significant role in the development of neuron in infants and in fat glycomic control (Mozaffarian et al., 2005). It had been estimated that about 80% of the animal protein in our diet comes from fish (Begum M et al., 2010).

1.3 Principal components of fish muscle

The principal components of fish muscle are –

Water- Approximately 80% of the weight of a fresh fish fillet is constituted by water but average content of water of fatty fish is about 70%. In fresh fish muscle the water content is strongly bound to the proteins and cannot be easily removed even under higher pressure. However, some of the water contents may be lost which contains dissolved substances. When the spawning time approaches in the living fishes, water contents increases where as protein content decreases

Protein- Approximated protein contents in the fish muscle are usually 15 to 20%, but in some rare species the values are lower than 15% or higher than 28%. Some of the amino acids are essentially required in human diet for the good health. Moreover, for the economic utilization of a diet, amino acids must be present in requisite proportions. Fish proteins are generally enriched in two essential amino acids called lysine and methionine. Thus fish food provides good nutritional requirements to human diet and is favourably compared with that provided by meat, milk and eggs.

Fats- The ratio of highest to lowest fat values is more than 300 to 1 (FAO, 2001). Fatty fishes usually show remarkable seasonal variations in the fat content. The water content of a fish generally falls with the rise in fat content maintaining a constant value between the sum of water and fat values at about 80%. But the protein content of a fish is directly proportional to the fat content. The fat values of fatty fishes are not distributed uniformly throughout the flesh of the species. The fat content of the muscle of a white liver is usually below 1%.

The minor components of fish muscle includes-

(i) Carbohydrates
(ii) Minerals & vitamins

Carbohydrates- In white fish muscle carbohydrate content is generally too small to play a significant role in the human diet.

Minerals &Vitamins- Minerals & vitamins have vital importance in the human diet not only to upgrade a good health but also for the maintenance of life itself. Fish provides well balanced set of minerals in usable form. There are two groups of vitamins. Some are fat soluble such as Vit A, D, E & K and some are water soluble such as Vit B & C.More or less all the vitamins, required for the good human health are present in fish.

1.4 Proximate Composition of Fish:

Proximate analysis mainly focuses on the quantification of several nutritional contents of fish. The nature and quantity of nutrients in most animals is dependent on their feeding habits. The nutritional characteristics of fish product are of keen interest to consumers. The flesh of fish in good condition is consisted of five main chemical component as protein, lipid, water, mineral and vitamins.

Proximate analysis are experimented adopting several standard methods to estimate vital components of nutritional status of fish; such as moisture, protein lipid and ash. The nature and quantity of nutrients in most animals are dependent on their feeding habits. The nutritional characteristics of fish product are of keen interest to consumers.

Fish fillet is comprised of many components such as moisture, lipids, proteins, vitamins and minerals. All of them contribute towards the total meal composition. The composition of fish body is affected by both exogenous and endogenous factors (Huss, 1995). The exogenous factors affect the body composition as well as the diet of the fish (composition, frequency) and also their existing environment (salinity, temperature). A number of researchers examined the influence of temperature, light, pH and the oxygen concentration on the proximate composition of fish. The endogenous factors are genetic and linked to the life stage, size, age, sex and anatomical position in the fish (Huss, 1995).

1.5 Fatty acid Profile:

Fish gains importance from medical point of views also. Previous researchers reported the presence of high content of polyunsaturated fatty acids (PUFA) in the fish flesh and fish oil which make them beneficial in decreasing the serum cholesterol.(Stansby., 1985).The PUFAs are very much effective for an age related disease like macular degeneration(AMD) in elderly (Johnson et al.,2006).For the paediatric population, the PUFAs are essential in the prevention of asthma ,a major health problem (Artemis et al., 2002).Poly unsaturated fatty acids are also vitally important for another health problem ,attention–deficiency hypatic disorder (Meyer et al .,2009). Fish lipids are the prime sources of polyunsaturated fatty acids (PUFAs) especially eicosapentaenoic acid (EPA; C_{205}) and docosahexaenoic acid (DHA; C_{226}) (Osamam et al., 2015). These two essential fatty acids cannot be synthesized by human body and hence should be obtained from the diet.

Lipids & fatty acids play a vital role in membrane biochemistry and directly linked to the membrane-mediated process in human such as osmoregulation, nutrient assimilation and

transport (Haliloglu et al., 2004). Lipids are major sources of metabolic energy and essential for the formation of cell and tissue membrane (Babu et al., 2010). Fatty acids in fish oil are vital source of omega-3-fatty acids, which play a significant role in human nutrition, disease prevention and health promotion (Frenous et al., 2014).

The specific knowledge of fish composition is essential for its scientific utilization. Fish meat contains significantly low lipids and higher water content than beef or chicken and hence favoured over other white or red meats (Neil, 1996; Nestel, 2000).

Many evidences suggested that fish meat and oil is enriched with high amount of polyunsaturated fatty acids which are important in lowering the serum cholestoral to prevent the coronary heart disease (Nordev et al., 2001; Turkmen et al., 2005). Consumption of fish promotes the defence mechanism for the protection against invasion of human pathogens because fish food contains antimicrobial peptide (Ravichandran et al., 2010). Fishes can reduce the risk of developing dementia, including Alzheimer's diseases (Grant, 1997). Fish fed mothers can give birth to healthy babies. The omega-3-fatty acids are transmitted to breast milk. Fish oil holds good in treating dys-lipidemia in diabetes (Friedberg et al., 1998). Consuming fish during pregency reduce the risk of delivery of a premature baby (Olsen and Secher., 2002).

Polyunsaturated fatty acids (PUFA) have been recognized as important substances with beneficial properties for the improvement of visual function (Carlson et al., 2013).Fish oil is rich in (PUFA). Fish is referred to as the 'rich food of the poor' (Béné et al., 2005). India is one of the 17 global mega biodiversity hot spot. This country is native place to many freshwater fish species. About 450 species, out of the 765 fresh water species are categorized as small indigenous fishes, defined as fish that grow up to 25-30 cm in length. The small fish species are of huge demand of different communities of the country. In the last few years the interest for quality of food, dietary fats as well as their effects on human health has been significantly increased. It is commonly known that the diet having low fatty acids is always healthier but for the sake of both proper development and perfect functioning the human body is in need of a specific amount of fats (Bratu et al., 2013).

The intake of foodstuffs which include large contents of saturated fatty acids is associated with major health problems like as heart disease, diabetes, cancer, therefore the diet must contain unsaturated fatty acids. PUFA, especially W-3 fatty acids (DHA, EPA) are known as essential fatty acids as the human body cannot synthesize them and hence they must be

provided from the diet (Fournier et Al., 2006). Fishes are regarded as the main natural source of essential fatty acids in human diet (especially EPA and DHA). Fish oil is studied to have the highest amount of w-3 PUFA (Rodrigueng et at., 2010; Mbatia et al., 2010; Russo et al., 2009).

1.6 Amino acid profile of Fish:

In most third world countries, food insecurity is one of the alarming issues of national concern (Owage et al., 2010). Fish food is enriched with high nutritive value especially high quality edible protein comprised of the ten essential amino acids in acceptable contents for the human consumption. Fish meal provides essential omega 3 fatty acids, vitamins A, B , D and a lot of minerals as like as Calcium, Potassium Phosphorous, iron, copper and iodine needed for both infant and adult food supplements. (Owaga et el., 2010; Saito et al., 1997).For this, the fish industries are regarded as very important sector. It contributes to the alleviation of food insecurity (Owaga et al., 2010). Incidentally, small fishes are admired in all classes of the society due to their good taste, high availability and definitely for their comparatively low price. These small fishes are nutrient dense and sometimes overlooked (Roos et al., 2007).

The fish products are the most important sources of animal proteins in the human diet. It includes all the ten essential amino acids in permitted quantity for human consumption. Fish protein is enriched with methionine, lysine and low with tryptophan compared to mammalian nutrients required for supplementing infant as well as adult diets (Abdullahi et al .,2001). Fish proteins are rich in essential amino acids (EAA) and needed for the acceleration of growth, reproduction and synthesis of vitamins

1.7 Mineral Profile :-

Developing countries face challenges by nutritional problems due to poverty, natural disasters, political imbalances (Mogobe et al., 2015). The chemical elements which are needed for the normal maintenance of the human body are known as essential elements in human nutrition (Jiang et al., 2015). These elements take part in many biochemical reactions viz Calcium, magnesium and phosphorus are vitally important in the formation of bones and teeth; sodium and potassium jointly work in the transmission of nerve impulses and controlling the electrolyte balance; zinc is mainly found as a cofactor in enzyme reactions, iron forms part of the haemoglobin molecule which carry oxygen throughout the body (Alas et al., 2014; Ansah et al., 2012). Human being may suffer from many diseases like anaemia, osteoporosis, goitre, stunted growth and genetic disorders etc. caused by mineral deficiencies (Bhandari & Banjara, 2014; Fumio et al., 2012; Asieh et al., 2011; Watanabe et al., 1997). As per the report of the

WHO, about 2 billion of the world's population are being suffered from mineral as well as vitamin deficiencies and the majority of them belong to the third world countries (FAO/WHO, 2001). Micronutrient deficiencies are highly pronounced in the populations of developing countries (Kawarazuka & Bene, 2011). Fish stores minerals in the head and viscera, so, the small fishes which are eaten whoel, may have a significant contribution towards micronutrients intakes (Mogobe et al., 2015).

1.8 Fish diversity

The Northeast India has a unique topography and watershed pattern and hence an attractive field for ichthyological studies. This part of India is identified as a global hot spot of freshwater fish diversity (Koltelate & Whitten, 1996). Recently many new species have been documented from the status of northeast India (Sen & Biswas, 1994; Biswas, 1997; Menon et al., 2000; Vishwanath & Shanta, 2004) opening the scope for exploring on the nutritional qualities of the fishes. The fish food is included in the diet of almost all the communities. A lot of works has been done on the nutritional status of fish, but only few attentions glimpsed on the small fish species. All around the country it is evidenced that the small fishes of low market cost, are consumed mostly by the common people due to their availabilities in all seasons.

In India rivers make the backbone of capture fisheries. Including major and minor, at least 113 rivers are there in this country (Baro et al., 2014). A mixture of distinctive habitats in a river qualify it one of the most productive eco system on the mother earth (Das & Sharma, 2012). Due to the presence of number of endemic fish species, the North East India is familiar as 'Global hotspot' for fish faunal diversity (Baro et al., 2014). An area of 101232 ha of Assam, India is covered with fresh water wet lands. The nearest wet lands are the only source of fish for the rural poor people (Baruah et al., 2000). The nutritional aspects of fish species available in the local wet lands were chosen for the topic of study in the present work. The proper information of the nutritional values of these small fishes may increase their market value and these might be commercially more exploited.

1.9 Scope of studies:-

The Kokrajhar district is enriched with many ponds, beels, wetlands and water tanks. The lion's share of total fish production originates from diplaibeel, Gour beel, Haloidal beel and above all the Gauranga river. Its strategic location is blessed with beautiful forests with flora and fauna.

The knowledge of the nutritional quality of the small fishes will make the door open to study about the extent of potentiality of the small fish species. It will open the door to the researches to investigate the advantage and disadvantage of consuming the small fishes. The present work will make the local people aware of the nutritional values of the fishes they consume. The studies on nutritional contents of small indigenous fishes are important to assure the local people about the vital role of this small fish on the human health and also to highlight the excellence of these fishes as a useful product for commercialization. The small fishes are widely appreciated by the poor villagers due to ease of their availability in the local water bodies like ponds, beels and many other wet lands. The small species are sometimes overlooked and are not commercially explored to a large extent as compared to the costly popular large fishes. The health condition of the poor people is mainly concerned to the food values of the most available natural species. Quantification of the nutrients of small selected fishes will ensure the common people about their benefits. It will help the nutritionists and dieticians to provide 'dietary guidelines' for the well being of the society (Mahanty et al., 2011). The research work on this area will make the community forwarded to adopt the necessary measures for the sustainable development of the aquatic resources. The local people would become serious enough to take all the necessary measures to protect the tiny creatures.

1.10 Aims and objectives of the research:

The aims and objectives of the present work are pointed out as below:

(i) To study on the proximate composition of selected small fish species from Kokrajhar BTAD, Assam;

(ii) To estimate the amino acid profile of the selected fish species.

(iii) To find out the fatty acid, mineral and vitamin contents of the selected small fishes.

(iv) To study the diversities of small fish species in Kokrajhar BTAD, Assam and their habitat quality

(v) To highlight the nutritional importance of selected small fishes to the consumers.