ARTEMIA MEAL: A NEWER ANIMAL PROTEIN SOURCE FOR POULTRY

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ABSTRACT

Artemia or Brine shrimp is a crustacean animal that lives in over 500 tropical and subtropical regions in the World. In Iran there are 12 regions of artemia habitats. Artemia in different stages of living normally exists for newly hatched shrimps, sturgeons, trouts, aquarium fishes as well as some crustaceans. However, artemia biomass is suitable protein for other animals such as poultry. Results indicated that artemia meal could be used as feedstuff in poultry and other farm animal diets, because of its high level of protein and high protein digestibility. Protein or amino acids content and metabolizable energy varies among different kinds of artemia present in various locations. This characteristics depends on, region, species, time of harvest, percentage of artemia mixture, because artemia of different ages showed different compositions.

Key words: Artemia, Brine shrimp, Protein.

Even though, meat and bone and fish meals have been exclusively used in poultry feeding, but artemia biomass is also one of the animal proteins with high nutritional value which can be used in aquaculture and animal nutrition (Abatzopoulos et al., 2002, Gilbert, 1995).

In this review the status of artemia as a source of protein is presented and information on this new animal protein ingredient, is provided.

What is artemia?

Artemia or brine shrimp belongs to the animal kingdom, phylum of arthropoda, subphylum of crustacean, branchiopoda class, anostraca order, artemidae family and artemia genus. Linnaeus (1758) and Leach (1819) called it cancer salinus and artemia salina, respectively. The latter name is because of the effect of salinity on morphological growth and development of artemia. Two species of artemia in Iran are: Artemia urmiana and Artemia parthenogenetica. The first is native of Urmia Lake.
and the second was observed in 12 regions of artemia habitats in Iran.

Artemia is spread in tropical and sub tropical regions of the world in saline environments and over 500 artemia regions are discovered around the globe. Almost nine artemia species were recognized in these regions.

More than two million kilograms of dried cysts of artemia with 0.4mm diameter are transacted in world market every year. It is used for hatched nauplius as an aquaculture feed. Uniformity of cysts and embryo with diapose has made artemia as a unique source of aquaculture feeds. Artemia cysts can spread by wind and migratory birds. Artemia contains 40-60% crude protein (dry matter basis) (Sorgeloose, 1989).

**Morphology and Ecology**

Morphologically, artemia has fragmented body with leave with wide shape appearance. Body consists of three compartments; head, thorax and abdomen, with total length as 8-10 mm and 10-12 mm in male and female respectively (Figure 1).

Width in both sexes is 4mm. The exoskeleton of artemia is extremely thin (0.3-1μ) and flexible called; chitin and it is connected to muscle from inner surface. The blood circulatory system of artemia is open.

This animal is euryhalin and can tolerate high concentration of salt habitat. There is a glandular organ in back of artemia neck that named; “salt gland” or “neck organ”. This organ exudates extra salt from the body to environment. Salt organ extincts at maturity and then this function is performed by exopodits of legs.

Although there exist some limitations in the living environment of artemia, like high temperature and high salinity and drought, this animal can tolerate these conditions by producing cysts and going to diapose until the conditions become suitable, then it continues living.

Salinity and temperature are two important factors for growth and survival of artemia. Artemia can tolerate salinity even over 250 g/l and suitable range of temperature is 6-35°C. This crustacean

**Figure 1:** Artemia morphology a) female and b) male
has adapted itself with hard environmental condition. In hypoxia, artemia increases the amount of hemoglobin through increased oxygen carrier capacity. In this situation, body color turned red from original pale brown. Physiological adaptation of artemia in high salinity is an effective defense method against predators, these mechanisms, include a) powerful and effective osmoregulator system, b) overcome high hypoxia in high salinity condition by higher pigmentation (inhalation pigments) and c) Production of embryos in diapose stage in cysts that can tolerate environmentally unfavorable condition.

Nutrition
Artemia, from nutrition standpoint is non selective filter feeder, and eats alges, bacteria, protozoa and yeasts, as long as feed particles diameter is not over 50-70 µm. Artemia feed can be alive or dead in artificial culture system. It uses external bacteria as feed and both bacteria and protozoa which grow in artemia culture medium, can produced necessary feed for its own need and artemia. This protozoa (such as; Candida, Rhodotorula) can also be directly swallowed by artemia. The best algae for artemia nutrition includes: Dunaliella salina, Spirulina and Scenedesmus. For artemia cultures agriculture products such as; rice, corn, wheat, barley flours and their brans, can be utilized.

Reproduction
All bisexual species holds 42 chromosomes (2n = 42). A.persimilis holds 44 chromosomes (2n = 44) and Artemia partenogenic is diploid, triploid, tetraploid and even pantaploid. As a general rule, artemia populations are defined the number of their chromosomes. However, contrary to mammalian, female artemia is heterogametic (Bowen,1964). Artemia is produced by two ways: sexual and parthenogenesis (development of a new individual from an unfertilized egg). The mature female ovulates every 140 hours.

According to strain of artemia or method of living, it selects one of the following conditions; oviparous or ovoviviparous. In suitable situation of rising, reproduction trend is as larvae production (ovoviviparous) and in unsuitable situation of growth (salinity >50gm/lit and oxygen <5mg/lit) oviparous will occur. In the latter condition, growth of embryo will stop and enters diapauses. In suitable salinity and nutrition, females can produce 75 nauplius each day and over its lift cycle (50 days), it reproduces 10-11 times. In extreme hypoxia, due to increased hemoglobin production, the color of artemia will change from light brown to yellow and then red. Artemia cysts are spread by wind and birds. Earth pond or region of high salty water is suitable for culture and reproduction of artemia.

Importance of artemia in poultry nutrition:
Various forms of artemia such as Decapsulated cysts, Newly hatched nauplii, Metanauplii and juvenile and adult, Frozen and freeze – dried artemia, are commonly used for newly hatched shrimps, sturgeons, trouts, aquarium fishes and some crustaceans. Artemia biomass is a suitable protein resource for other animals like poultry that consist of different stages of artemia growth.

Methods of artemia harvesting
According to artemia habitant, different biomass harvesting is utilized. In breeding pools and lake beaches, artemia is collected using a lace net that is fastened to two large floats from each side (figure 2). Since artemia is phototropism, it can be collected easily by light source at night.

After harvest, artemia biomass can be dried and cured under sunlight (Figure 3). Then the dry artemia will be milled to be used in poultry diet.

Chemical composition of artemia meal
The chemical composition of different kinds of artemia meal (dried at 50-60°C as sun cured or oven dried) is shown in Table 1. As shown in Table 1, the chemical composition of 3 kind of artemia meal (collected from different regions of Iran) is not identical. The quality, depends on, region, species, time of harvest, percentage of artemia mixture (artemia in different stages of living shows different
composition). So prior to using this ingredient, it must be analyzed for main nutrients.

Metabolizable energy of artemia meal

An experiment which designed for qualification of different classes of ME (AME, AMEn, TME, TMEn) in artemia meals (Zarei, 2006). The method of experiment was according to procedure (Sibbald, 1976), showed that the amount of ME in different kinds of artemia varies according to following order:

AME (2131 to 2858), AMEn (2298 to 2803), TME (2808 to 3500), TMEn (2554 to 3066)

Protein and amino acids digestibility of artemia meal

Results from in vitro and in vivo experiments showed that this ingredient has high quality of protein (Zarei, 2006) and the amount of digestibility was more than 90%. The results from amino acids digestibility of artemia showed that in the determination of apparent amino acid digestibility of excreta, serine had the lowest (0.80) and methionine had highest (0.92) digestibility. Glycine showed the lowest (0.88) and arginine and leucine had the highest (0.95) apparent ileal digestibility. In measuring true excreta and ileal amino acid digestibility, alanine and glycine had lowest (0.90 and 0.93) and methionine had highest (0.96 and 0.99) digestibility, respectively. Generally the measurement site did not influence the apparent or true amino acid digestibility (Aghakhanian, et al 2009).

Artemia meal in broiler diets

In another experiment, two kinds of artemia meal including ULAM and EPAM, were replaced at 5 levels of protein substitution (0, 25, 50, 75, 100%) for fish meal proteins in broiler diets (Zarei, 2006). Results from this experiment showed, there is no significant difference between treatments from standpoint of weight gain, feed conversion ratio and carcass traits.

CONCLUSION

Results of this study revealed that artemia meal because it has high level of protein and high protein digestibility, can be used as a feedstuff in poultry and other farm animal’s diets. Compared with other animal proteins, artemia does not contain any feather, bone, hair or gastrointestinal tract components. In addition, in artemia production there is no requirement for high pressure and high temperature treatments which can influence protein quality. Artificial culture of artemia is easy and is possible everywhere.
### Acknowledgments

We offer our thanks to Chairman, Vice President and personnel of Karaj Islamic Azad University, Iranian Ta b l e  1 : Chemical composition of three kinds of artemia meal (ULAM2, EPAM3, GSLAM4) (as g/kg, MJ/kg or mg/kg – DM basis) 1

<table>
<thead>
<tr>
<th>Chemical composition</th>
<th>Kind of Artemia meal</th>
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<tbody>
<tr>
<td></td>
<td>ULAM</td>
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<tr>
<td>Dry matter</td>
<td>928</td>
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<tr>
<td>Crude Protein</td>
<td>401.9</td>
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<tr>
<td>Crude Fat</td>
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<td>Crude Fiber</td>
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<td>Copper (Cu)</td>
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<tr>
<td>Zinc (Zn)</td>
<td>52.75</td>
</tr>
</tbody>
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1- Zarei, A (2006)  3- Earth Pond Artemia Meal
2- Urmia Lake Artemia Meal  4- Ghom Salt Lake Artemia Meal

### REFERENCES


