protein are rarely recycled and reused due to their high recycling cost and low product value. However, shrimp shell protein contains all kinds of essential amino acids, has high nutritional value, and has potential market value in agricultural farming and supplementation food. If the protein cannot be recycled in time, it will not only waste resources, but also decay quickly and easily cause environmental pollution. Therefore, strengthening the recycling of protein and calcium carbonate is also an urgent problem to be solved in the treatment of shrimp and crab shells. In fact, amino acids and calcium are essential nutrients for plant growth. Although the waste liquid extracted from chitin contains a large amount of protein and calcium, it cannot be directly used as a fertilizer. The main reasons are: 1. Traditional waste liquid contains a lot of sodium ions and chloride ions. At present, the level of NaCl in soil worldwide is seriously excessive and salinization is a very serious problem to consider. Excess salt can have a serious impact on plant growth and physiological activity. 2. After the neutralization of the protein-rich alkaline waste liquid in the traditional production process, the protein will precipitate in a large amount when it reaches the isoelectric point due to the large molecular weight, and the soluble protein or amino acid solution cannot be formed. The solid protein is difficult to be absorbed by the plant. Therefore, it is necessary to develop a sustainable method for utilization of crayfish and shrimp shell waste, which can improve the separation efficiency of chitin, reduce the cost, and effectively utilize protein and calcium, and reduce the discharge of waste and waste liquid.

The technical problem underlying the present disclosure was thus the provision of an improved, preferably sustainable method, for extracting chitin from chitin containing materials, which overcomes the above-mentioned drawbacks. Furthermore, the method should not only make the chitin available, but also other components such as calcium carbonate and proteins, which are to be found in the chitin containing material.

Thus, the present disclosure relates to a method for treating a chitin containing material comprising

(i) milling the chitin containing material; and

(ii) contacting the milled chitin containing material from step (i) with a mixture comprising an aqueous solution of an organic acid; and/or

(iii) contacting the chitin containing material with an alkaline solution comprising water:glycerol in a ratio of 50-100:1-50 (v/v) and potassium hydroxide at a concentration of from 0.2M to 5M, preferably of from 0.5M to 2 M, more preferably of about 1M, most preferably of 1M;

thereby treating the chitin containing material.

In an aspect, there is provided a method for treating a chitin containing material comprising

(i) milling the chitin containing material;

(ii) contacting the milled chitin containing material from step (i) with a mixture comprising an aqueous solution of an organic acid; and

(iii) contacting the chitin containing material with an alkaline solution comprising water:glycerol in a ratio of 50-100:1-50 (v/v) and potassium hydroxide at a concentration of from 0.2M to 5M;

thereby treating the chitin containing material.

In another aspect, there is provided a method for producing a fertilizer or a food or feed or a feed or food additive, comprising the steps of the method as defined above and optionally the steps of formulating the product obtained as fertilizer or optionally the step of formulating the product as food or feed or optionally the step of formulating the product as food or feed additive

In another aspect, there is provided a method of producing a chitin and at least one of a calcium salt of an organic acid, a protein product, and astaxanthin from chitin containing material, comprising the steps as defined above.

In another aspect, there is provided a chitin preparation, a calcium salt of an organic acid, a protein product, or an astaxanthin produced or producible from chitin containing material according to a method as defined above.

In another aspect, there is provided the use of a chitin preparation as defined above in manufacture of a natural or synthetic polymer, in agriculture, in packaging, in construction, or in environmental protection, as an ingredient in the production of a medicament, a food, or a cosmetics, and/or as a solidified enzyme carrier.

The method proved to be a sustainable method and gave far better results than the classic method in view of less degradation of the final product and generated wastes. Furthermore, the sustainable method was the less aggressive method compared to the classic one and resulted in a slightly higher yield. In addition, the sustainable method allowed the use of by-products, which have high market values.

In general, terms used herein are to be given their ordinary and customary meaning to a person of ordinary skill in the art and, unless indicated otherwise, are not to be limited to a special or customized meaning. As used in the following, the terms “have”, “comprise” or “include” or any arbitrary grammatical variations thereof are used in a non-exclusive way. Thus, these terms may both refer to a situation in which, besides the feature introduced by these terms, no further features are present in the entity described in this context and to a situation in which one or more further features are present. As an example, the expressions “A has B”, “A comprises B” and “A includes B” may refer to a situation in which, besides B, no other element is present in A (i.e. a situation in which A solely and exclusively consists of B) or to a situation in which, besides B, one or more further elements are present in entity A, such as element C, elements C and D or even further elements. Also, as is understood by the skilled person, the expressions "comprising a" and "comprising an" preferably refer to "comprising one or more", i.e. are equivalent to "comprising at least one". In accordance, expressions relating to one item of a plurality, unless otherwise indicated, preferably relate to at least one such item, more preferably a plurality thereof. Further, as used in the following, the terms "preferably", "more preferably", "most preferably", "particularly", "more particularly", "specifically", "more specifically" or similar terms are used in conjunction with optional features, without restricting further possibilities. Thus, features introduced by these terms are optional features and are not intended to restrict the scope of the claims in any way. The invention may, as the skilled person will recognize, be performed by using alternative features.