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# CAPSULE CONTAINING A PHARMACEUTICALLY USEFUL RADIOACTIVE MATERIAL

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This invention relates to radioactive pharmaceutical preparations and, more particularly, to an improved encapsuled form for the administration of radioactive materials for diagnostic purposes.

It is frequently desirable that means be provided for tracing the course of a particular medicament or diagnostic agent in the system of a patient undergoing treatment. One technique which has been employed widely in the last several years makes use of the properties of radioactive substances in order to achieve this objective. However, the liquid radiopharmaceutical preparations heretofore available have suffered from certain disadvantages, primarily from difficulties in handling and in administration inherent in the use of a liquid preparation. There is, therefore, a continued demand for the development of radio-active pharmaceutical preparations in a form which is easier to standardize and handle and which is simpler to administer.

It is, therefore, an object of the present invention to provide readily administrable preparations of radioactive materials.

Other objects of this invention will in part be obvious and will in part appear hereinafter.

It has been found that the above and other objects can be achieved by the provision of the novel capsules of the present invention in which the radioactive material is adsorbed on a plug of porous, non-toxic material inserted in a capsule of a conventional, pharmaceutically acceptable encapsuling substance. More particularly, it has been found that an improved form for the administration of radioactive materials can be provided by forming a solution of a radioactive material in a relatively volatile, substantially non-aqueous organic solvent, depositing a predetermined volume of said solution on a plug of porous, non-toxic material and then removing the solvent, whereby the radioactive material is thoroughly retained as an adsorbent on the plug. Either prior to or after such treatment the plug is inserted into a capsule.

In a preferred modification of the present invention the plug is first inserted into the capsule and the solution of the radioactive material which is deposited on the plug contains a sugar, i.e. glucose, which, upon the evaporation of the solution, acts as a binder and firmly secures the plug to the surrounding capsule wall.

The present invention thus affords a product containing a radioactive material in a form which is easier and simpler to standardize and to handle than has heretofore been available. More particularly, the products of the present invention contain the radioactive materials in a form which provides for far greater ease of administration. It has been found that the radio-pharmaceutical preparations of the present invention are easier for the physician to handle and to administer. In addition, it has been found that loss of radioactivity and the risk of radioactive contamination are greatly reduced.

The encapsulating material which is employed in the preparation of the products of this invention may be any substance commonly employed in the art for this purpose. In general, it has been found that gelatin capsules are the most suitable for use in the present invention. However, other thermoplastic, water soluble non-toxic materials which are therapeutically acceptable are likewise susceptible of use in preparing the products of the present invention. Illustratively, methyl cellulose and polyvinyl alcohol can be employed as encapsulating materials.



The plug which is inserted into the gelatin capsule and on which the radioactive material is adsorbed may be any porous, non-toxic matrix which can be ingested and rapidly disintegrated in the gastro-intestinal tract. Preferably, the plug is a foamed gelatin, such as the gelatin sponge disclosed in U.S. Patent No. 2,465,357, but it is obvious that other materials absorbable by the body having the requisite properties specified above can also be employed.

The solvent employed in forming the solution of the radioactive material may be any relatively volatile, substantially non-aqueous organic solvent. Suitable solvents are methanol, ethanol, acetone and dioxane. Aqueous ethanol having an ethanol content of at least 80% can also be employed.

The radioactive material employed in the products of the present invention can be any radioactive organic or inorganic compound which will give a homogeneous solution in a substantially non-aqueous, relatively volatile solvent. The preferred radioactive materials are those which are pharmaceutically useful and adsorbable from the gastro-intestinal tract. Thus, the following materials may be employed: radioactive sodium iodide (I–131), radioactive sucrose, radioactive phosphoric acid, radioactive vitamin $B_{12}$; antibiotics containing a radioactive element, such as penicillin containing radioactive carbon$_{14}$; and radioactive elements, such as potassium, rubidium, iron, zinc and copper.

For a fuller understanding of the present invention reference is made to the following examples, which are for illustration only and are not to be construed as limiting the scope of the present invention.

*Example I*

A plug of foamed gelatin (a porous, absorbable, gelatin sponge) which has a diameter slightly larger and a length slightly less than that of the lower portion of a gelatin capsule is inserted into the said lower portion of the gelatin capsule and is tamped down with a steel rod having a diameter slightly smaller than that of the capsule. 0.2 cc. of a solution consisting essentially of 0.5 g. of glucose, 4 ml. of water, a sufficient quantity of absolute alcohol (ethanol) to bring the total volume to 50 ml. and sufficient radioactive sodium iodide (I–131) to provide a capsule having an activity of 200 mc./cc. is pipetted onto the plug. The filled capsule is then placed in a dessicator where it is evacuated slowly over a period of two hours. At the end of this period the cap of the capsule is applied, preferably after a slight wetting with a trace of water or other suitable hygroscopic solvent. In approximately one hour the seal is complete.

*Example II*

A plug of foamed gelatin (a porous, absorbable gelatin sponge) which has a diameter slightly larger and a length slightly less than that of the lower portion of a gelatin capsule is inserted into the said lower portion of the gelatin capsule and is tamped down with a steel rod having a diameter slightly smaller than that of the capsule. 0.2 cc. of a solution consisting essentially of 4 ml. of water, sufficient absolute alcohol (ethanol) to bring the total volume to 50 ml., and sufficient radioactive sodium iodide (I–131) to provide a capsule having an activity of 200 mc./cc. is pipetted onto the plug. The filled capsule is then placed in a dessicator where it is evacuated slowly over a period of two hours. At the end of this period the cap of the capsule is applied, preferably with slight wetting with water, and in approximately one hour the seal is complete.

*Example III*

0.2 cc. of a solution consisting essentially of 0.5 g. of glucose, 4 ml. of water, sufficient absolute alcohol ethanol) to bring the total volume to 50 ml. and sufficient radioactive sodium iodide (I–131) to provide a capsule having an activity of 200 mc./cc. is pipetted onto a plug of foamed gelatin (a porous, absorbable gelatin sponge). The plug of foamed gelatin is then inserted into the lower portion of a gelatin capsule, said lower portion having a length slightly greater and a diameter slightly less than the plug of foamed gelatin. The gelatin plug is tamped down with a steel rod having a diameter slightly smaller than that of the capsule. The filled capsule is then placed in a dessicator where it is evacuated slowly over a period of two hours. At the end of this period the cap of the capsule is applied, preferably after a slight wetting with a trace of water or other suitable hygroscopic liquid. In approximately one hour the seal is complete.

While radioactive sodium iodide (I–131) has been specifically employed in the above examples, it is obvious that the other radioactive materials referred to at an earlier portion of this disclosure can likewise be employed.

It will also be obvious to those skilled in the art, that the various steps of the procedures set forth in Examples I and II, such as the insertion of the plugs, the tamping down of the inserted plugs and the pipetting of the solution of the radioactive material into the capsules, can be performed either by hand or automatically.

It will also be apparent to those skilled in the art, that the procedures described in the foregoing examples can be suitably modified. Thus, in Example III, the treated plugs may be placed in a dessicator and dried prior to their insertion into the capsules.

The invention may be variously otherwise embodied within the scope of the appended claims.

What is claimed is:

1. An article of manufacture comprising a pharmaceutical radioactive two-piece capsule formed essentially of a non-toxic, water soluble, thermoplastic material adapted to being ingested and rapidly disintegrating in the gastro-intestinal tract, said capsule enclosing a plug of a porous, non-toxic, spongy material adapted to being ingested and rapidly disintegrating in the gastro-intestinal tract, said plug having its side areas contiguous with the walls of said capsule, and a pharmaceutically useful radioactive material absorbable from the gastro-intestinal tract absorbed on said plug.

2. The article of manufacture of claim 1 in which the thermoplastic material is gelatin.



3. The article of manufacture of claim 1 in which the plug is a porous, pliable, non-toxic gelatin sponge.

4. The article of manufacture of claim 1 in which the radioactive material is radioactive sodium iodide (I–131).

5. An article of manufacture comprising a pharmaceutical radioactive two-piece capsule formed essentially of a non-toxic, water soluble, thermoplastic material adapted to being ingested and rapidly disintegrating in the gastro-intestinal tract, said capsule enclosing a plug of a porous, non-toxic, spongy material adapted to being ingested and rapidly disintegrating in the gastro-intestinal tract, such plug having its side areas contiguous with the walls of said capsule, a coating of a sugar intermediate between said plug and said capsule walls whereby said plug is firmly adhered to said capsule walls, and a pharmaceutically useful radioactive material absorbable from the gastro-intestinal tract absorbed on said plug.

6. The article of manufacture of claim 5 in which the thermoplastic material is gelatin.

7. The article of manufacture of claim 5 in which the plug is a porous, pliable, non-toxic gelatin sponge.

8. The article of manufacture of claim 5 in which the sugar is glucose.

9. The article of manufacture of claim 5 in which the radioactive material is radioactive sodium iodide (I–131).

10. An article of manufacture comprising a pharmaceutical radioactive two-piece capsule formed essentially of gelatin, said gelatin capsule enclosing a plug of porous, pliable, non-toxic gelatin sponge, said plug having its side areas contiguous with the walls of said capsule, a layer of glucose intermediate between said plug and said capsule walls whereby said plug is firmly adhered to said capsule walls, and radioactive sodium iodide (I–131) absorbed on said plug.

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