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APPARATUS FOR QUANTITATIVE DETERMINATION OF FATTY MATERIAL AND WATER IN BIOLOGICAL TISSUE

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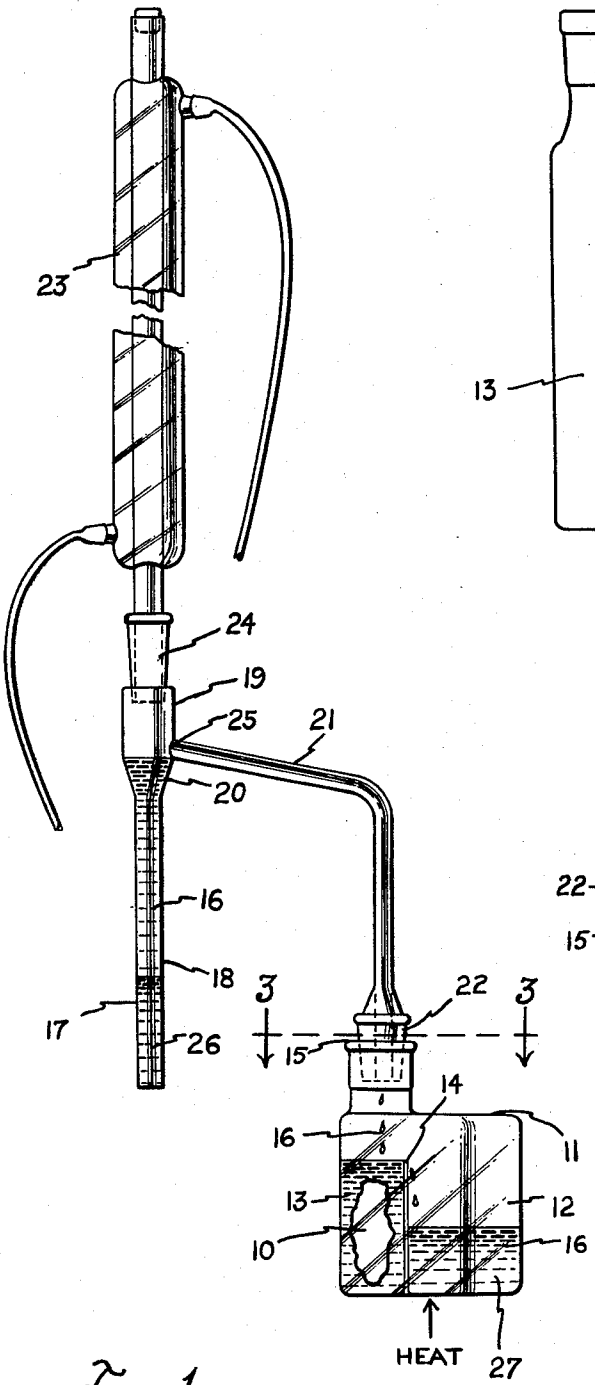


Fig. 1

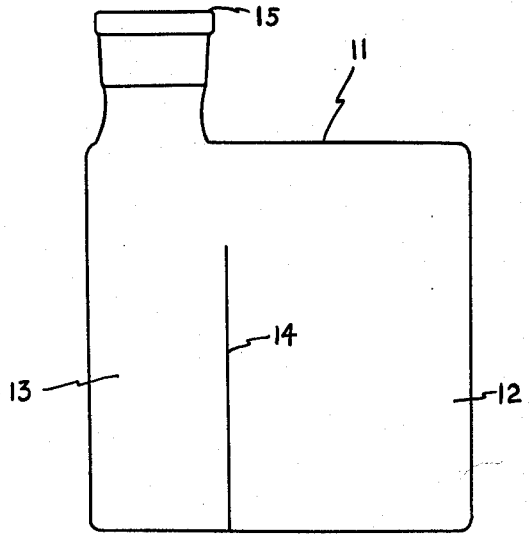


Fig. 2

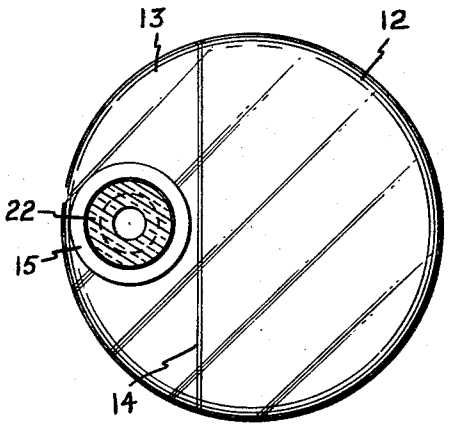


Fig. 3

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APPARATUS FOR QUANTITATIVE DETERMINATION OF FATTY MATERIAL AND WATER IN BIOLOGICAL TISSUE

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This invention relates to an apparatus and a process for separating the moisture and fatty material from organic material. Particularly, the invention relates to an apparatus and a process for quantitative extraction of fatty material and moisture from biological material.

The invention utilizes a unique and novel flask construction and process which permits the quantitative extraction of the fatty material and moisture in a given sample of biological material in a single process.

It is an object of this invention to provide a closed system for complete simultaneous quantitative removal from samples of organic tissue, particularly, chunks of meat and fatty material; and simultaneous quantitative separation of the fatty material and moisture from the samples and from each other, and from the proteinous or fibrous residual material left in the sample when the fatty material and moisture have been removed.

By utilizing a closed system in accordance with the instant invention, a high degree of accuracy and a substantially fool-proof arrangement results for the accomplishment of the objects hereof when compared with the prior are devices and procedures as will become more apparent hereinafter.

Other and further objects of the invention will be apparent from the following description and appended claims.

On the drawings:

FIGURE 1 is a side elevational view of one embodiment of the instant invention.

FIGURE 2 is an enlarged view of the flask shown at the bottom of FIGURE 1.

FIGURE 3 is a view taken substantially on line 3—3 of FIGURE 1 and looking in the direction of the arrows.

The prior art process for separation of moisture and fatty material and residual materials involves an initial step of removal of water from a sample by a heating for a long period of time in an oven or the like. Besides being greatly time consuming (such methods often taking as long as 24 hours), this old process requires the comparison of the weight before and after heating to determine the amount of moisture driven off. The second weighing must be made promptly after removal from the heat to minimize addition of moisture from the air. The heating required also may partially render some of the fatty material in the sample with resultant inaccuracy in the analysis of the fatty material and other substances.

In the process of the prior art, after the dried sample has been weighed, it is placed in an apparatus such as a solvent receiver which is intermediate between a flask containing a fatty material solvent and a reflux condenser. By heating the solvent flask the vaporized solvent passes up the side of the receiver to the condenser where it condenses and drips back into the receiver over the dried sample of the material, which is placed in the central chamber of the receiver. As the condensed solvent collects in the central chamber the return solvent rises to a level where it begins flowing through an over-flow tube back to the solvent receiving flask. The solvent bearing fatty material extracted from the dried sample is then intermixed with the original solvent and the continuous heating circulates the pure solvent upwardly and return solvent bearing fatty materials until the fatty materials

from the sample are substantially removed. The fat materials content of the sample is then determined by disconnecting the solvent flask containing the fat materials bearing solvent and driving the solvent off by heat and weighing the fat materials content remaining in the flask.

In accordance with the instant invention, an undried raw sample **10** of biological tissue, such as a piece of animal fat, is placed into a flask **11**, which comprises the unique apparatus of this invention. The flask is solvent receiving but is not equivalent to the solvent receiving flask of the prior art because flask **11** is divided into separate chambers **12** and **13** by wall **14**. Because wall **14** does not extend the height of the flask **11** chambers **12** and **13**, although completely separated to the top of the wall **14**, communicate at the top of wall **14**, as illustrated in FIGURES 1, 2 and 3.

In the preferred embodiment of the invention the chambers **12** and **13** are of unequal capacity with the smaller being disposed below the mouth or flask opening **15**. Good results are obtained in accordance with the embodiment described herein if compartment **12** has about three times the capacity of the smaller compartment **13**. As it will be apparent the dissimilar sizes of chambers **12** and **13** are not critical to the invention. It is critical, however, that there are provided facilitates and factors whereby the level of fatty materials solvent **16** during the process will cause it to spill from chamber **13** into chamber **12**. Such factors and their relationship will be apparent to those skilled in the art.

In practice the sample **10** may be placed in an extraction thimble (not shown) before being placed in the compartment **13**. The flask is then partially filled with fatty materials solvent **16** to a level which is somewhat below the top of the wall **14** which separates the bottom of the flask **11** into two compartments. It is essential to this invention that the level of the solvent in chamber **12** be below the upper edge of wall **14** to permit the spill-over of the solvent from compartment **13** into the compartment **12**, as will be more particularly described hereinafter.

The solvent **16** is an azeotropic fat solvent, that is, a fat solvent immiscible with water in the liquid state but miscible with water in the vapor stage. Among the preferred solvents for normal operation of the process are toluene, xylol and octanol. Of course, solvents of the above type can be selected having lower or higher boiling points, depending upon the temperature limits desired. For example, to preserve certain characteristics of the elements of the sample which may be altered or destroyed by higher heat a solvent having a boiling point below the alteration or destruction temperature should be used.

Above the flask is mounted a receiver, generally designated as **17**, such as for example, that known in the art as a Bidwell and Sterling receiver. The receiver **17** has a bottom portion comprising a vertical collection tube **18** which may be graduated and also has a condenser receiving joint **19** at its upper end portion. Between the joint **19** and the vertical collection tube **17** the receiver **17** has a central chamber **20** and a conduit or tube **21** which is disposed outwardly and downwardly. The lower end portion **22** of conduit or tube **21** is adapted to fit into the mouth **15** of the sample-containing flask **11**.

A reflux condenser **23** is disposed above the joint **19** of the receiver **17** with the lower end portion **24** of the said condenser fitted into the said joint.

The flask **11**, receiver **17** and condenser **23** are connected, as illustrated in FIGURE 1, after the sample and solvent are in place, to form a sealed unit. Heat from the heat source which is directed against the bottom of flask **11**, causes the solvent in the flask to boil and causes evaporation of the water in the sample. The solvent **16** and the water from the sample, in a vapor state, form an

azeotropic mixture and pass upwardly through the conduit or tube 21 of the receiver 17 and continue upwardly through the upper chamber 20 and joint 19 of the receiver 17 into the vertical collection tube 18.

The condensed water, being heavier than the solvent 16, collects at the bottom of the tube 18 with the condensed solvent stratified above the condensed water. Substantially pure solvent 16 which reaches the level of orifice 25 spills through said orifice outwardly and downwardly through the side tube 21 into chamber 13 which is aligned below the mouth 14 of flask 11.

As the process continues and the level of water 26 in receiver 17 rises, this causes an increase in the speed of the process because of the more rapid delivery of solvent 16 into chamber 13. It is apparent that tube 21 functions as a two-way conduit in which the azeotropic vapor comprising water and solvent is directed into condenser 23 and condensed pure solvent is directed into chamber 13.

As the spill-over solvent from the receiver tube 21 drips down through the mouth 15 of the flask 11 into the sample which is in the compartment 13, the solvent dripping over and circulating around the sample extracts the fatty material 27. When the compartment 13 is full, the fatty materials laden solvent spills over into the compartment 12, which in this embodiment of the invention contains the greater proportion of the raw solvent.

As the circulation continues due to the boiling and subsequent condensation, the condensed solvent continues to drip into the sample-containing compartment 13 and causes circulation over and around the meat sample continually to extract the fatty materials from the sample. Accordingly, a continuous and self-sustaining flow of the condensed solvent circulates over and around the sample with a relatively high degree of agitation which assists considerably in the dissolving of fatty materials.

From the foregoing it is apparent that for proper operation of the process the apparatus employed must insure that the fatty materials laden solvent 27 does not rise to a level above the wall 14 and also that the fluids build up in chamber 13 to a point where they will spill over the wall 14 into the chamber 12. Attention is invited to the fact that a number of aspects, readily apparent to those skilled in the art, could be employed to achieve this result. However, the one which is most obvious to me and probably the most simple, is by making chambers 12 and 13 of unequal dimension with chamber 13 substantially smaller than chamber 12 to insure a greater volume of evaporation of solvent from chamber 12 than occurs from chamber 13 to permit the build-up and continuous spill-over from chamber 13 into chamber 12.

It is also apparent, of course, that after all of the fatty materials and water have been removed from the sample 10 and the solvent extracted or removed in any suitable fashion that the residue in chamber 13, as well as the fatty material in chamber 12 and the water in receiver 17, can be quantitatively determined by simple direct measurement.

To insure the best result it would appear preferable that the solvent returning through the tube or conduit 21 should be precluded from dropping into chamber 12 and directed into chamber 13.

Inasmuch as many changes could be made in the above-described construction and process, and inasmuch as many apparently widely different embodiments of the invention within the scope of the claims could be constructed without departing from the scope and spirit thereof, it is intended that all matter contained in the accompanying specification shall be interpreted as being illustrative and not in a limiting sense.

I claim:

1. An apparatus for simultaneous and quantitative extraction of fatty material and water from biological tissue comprising a flask having an upper opening; a wall in said flask providing therein two chambers separated by said wall and communicating above said wall, one of said chambers aligned with said opening and adapted to contain the biological tissue; a tube providing a two-way path disposed in the opening in said flask; a condenser in non-alignment with said flasks and communicatively connected to said tube, said condenser adapted to condense water and solvent delivered thereby; and a separator communicatively connected to said tube and adapted to stratify condensed water and solvent and return the solvent through said tube to said first chamber, said separator disposed below the connection thereof with said tube.

2. An apparatus for simultaneous and quantitative extraction of fatty material and water from biological tissue comprising a flask having an upper opening; a spill wall in said flask dividing said flask into separate chambers whereby liquid in each chamber below the top of said wall is retained in the respective chamber and will spill from one chamber to the other upon reaching the top of said wall; one of said chambers adapted to contain biological tissue and aligned with the opening in said flask; a conduit providing a two-way path, said conduit having its lower end secured in the opening of said flask and extending upwardly therefrom at an angle; a reflux condenser and a water and solvent separator communicatively connected to the upper end of said conduit in non-alignment with said flask, the reflux condenser disposed above the separator whereby water and solvent in the vapor phase is delivered through said conduit to said reflux condenser and thereafter is stratified in the condensed phase in the separator with the solvent spilling into said conduit and returned to one of said chambers from which it spills in the liquid phase into the other thereof.

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