

## IMMUNOBEAD ASPIRATOR AND METHOD OF USE

### BACKGROUND OF THE INVENTION

The invention relates to aspiration devices for use with immunoassays of the type which employ immunobeads or immunoballs. More particularly, the invention relates to devices for aspirating fluids from test tubes, microtiter wells, or other immunoassay incubation vessels which contain immunobeads or immunoballs and which enhance the completion of the aspiration process by picking up the immunobead or immunoball.

For a conventional immunoassay, multiple liquids must be dispensed and aspirated from an immunoassay reaction vessel. The automation of immunoassays requires the mechanization of such multiple liquid dispensing and aspiration steps. The reliability of the immunoassay is dependent upon the accuracy of the dispensing steps and the completeness of the aspiration steps. Incomplete aspiration may result in the carry over of unreacted or unbound species from one step in the assay to the next. Such carry over may necessitate further wash steps or may result in the introduction of inaccuracy.

Immunoassays which employ immunobeads or immunoballs can be particularly difficult to aspirate completely. It has been found that lifting the immunobead or immunoball during the aspiration procedure reduces the amount of carry over liquid which remains between the immunobead and the bottom of the immunoassay incubation vessel. Aspirators having an inverted bowl may be employed for lifting the immunobead during such aspiration procedures. If a vacuum is pulled from this inverted bowl, the inverted bowl can lift the immunobead. To facilitate the capture of the immunobead, the inverted bowl may be given a shape which is complementary to the shape of the immunobead, i.e. the immunobead may fit snugly into the inverted bowl. To prevent the clogging of the vacuum port by the immunobead, longitudinal channels may be formed within the inverted bowl extending from the vacuum port to the rim. Aspirated liquids may travel within these channels to the vacuum source. The aspiration of liquids is also facilitated if the rim of the inverted bowl extends proximally to the side walls of the immunoassay incubation vessel. Accordingly, it has been found that liquids may be aspirated from the bottom of the vessel by lifting and capturing the immunobead and by then drawing the vacuum proximally to the wall of the vessel through these channels.

Unfortunately, the capture of the immunobead by the inverted bowl can cause liquid to be trapped within the contact area between the immunobead and the inverted bowl. Such trapped liquid can cause incomplete aspiration and liquid carry over.

What is needed is an aspiration device for use with immunobeads and immunoballs which can reduce the amount liquid carry over between aspiration steps.

### SUMMARY

The immunobead aspirator reduces the volume of carry over liquid by reducing the contact area between the immunobead and the inverted bowl. The immunobead aspirator employs an array of protuberances within the inverted bowl. The array of protuberances contacts the immunobead when it is lifted by the aspirator. However, the contact between the protuberances

and the immunobead is not snug. The array of protuberances define a hollow which is larger than the immunobead. Accordingly, the immunobead can not contact all of the protuberances simultaneously.

In a preferred embodiment, the immunobead has only point contact with the protuberances, as opposed to surface contact, i.e. the contact between the immunobead and the protuberances is limited to two or more points.

In a further preferred embodiment, the immunobead may be jostled during the aspiration process so that the points of contact between the immunobead and the protuberances may change several times during a single aspiration procedure. During a single aspiration procedure, such jostling can allow the entire surface of the immunobead to be free of contact with the protuberances at some point during the procedure. Accordingly, the carry over is further reduced.

### BRIEF DESCRIPTION OF THE DRAWINGS.

FIG. 1 is a sectional view of a test tube containing a liquid, an immunobead, and a portion of an immunobead aspirator. The immunobead aspirator has not yet captured the immunobead in FIG. 1.

FIG. 2 is an other sectional view of the assembly of FIG. 1. However, the aspirator has been further lowered into the test tube, the immunobead has been captured and the aspiration of the liquid has been largely completed. Note that the immunobead contacts only the protuberances on the left hand side of the inverted bowl in FIG. 2.

FIG. 3 is a plan view of the inverted bowl and protuberances of FIGS. 1 and 2 viewed from the bottom and rotated 45 degrees.

FIG. 4 is a fragment of a sectional view of the inverted bowl and protuberances of FIG. 3.

### DETAILED DESCRIPTION THE APPARATUS

The preferred embodiment of the aspirator (1) is shown in FIGS. 1-4. The aspirator (1) includes a neck (2) and an inverted bowl (3). The neck (2) is connected to the inverted bowl (3) and serves to extend the inverted bowl (3) into the test tube (4), microtiter well, or other immunoassay vessel for aspirating liquid (5) therefrom and for lifting the immunobead (6). The neck (2) is hollow. The hollow portion of the neck (2) is connected at one end to the inverted bowl (3) by means of a vacuum port (7) and to the opposite end to a vacuum source (8). The vacuum port (7) enables air and liquid (5) to be drawn from the test tube (4) through said inverted bowl (3) and said neck (2) and into the vacuum source (8).

The inverted bowl (3) faces downward as the aspirator (1) is inserted into the test tube (4). The inverted bowl (3) has a concave shape. The rim (9) of the inverted bowl (3) extends nearly to the wall of the test tube (4) or other vessel. The vacuum port (7) opens onto or near the apex of the inverted bowl (3). Accordingly, when the vacuum source (8) is activated, air is drawn around the rim (9) of the inverted bowl (3) and into the vacuum port (7). As the inverted bowl (3) is lowered toward the immunobead (6), the immunobead (6) is lifted from the bottom of the test tube (4) by the vacuum and drawn into the inverted bowl (3). The immunobead (6) will remain captured within the inverted bowl (3) for as long as the vacuum source (8) is activated.

The invention teaches that the volume of carry over liquids may be reduced by the addition of an array of