

TESTING VESSEL

This invention relates to a dissolution testing vessel, and in particular to a vessel for testing dissolution of pharmaceutical formulations, particularly buoyant pharmaceutical formulations.

In the field of pharmaceutical formulations there exists a need to study the behaviour of the formulations in vitro in such a way that the in vivo behaviour of the formulations can be predicted. Many different types of formulation are produced, for example, slow-release formulations which are designed to release active ingredient(s) over a given period of time at an approximately constant rate.

Other formulations may be designed to release an initial "burst" of active ingredient followed by a steady-state release thereafter. For these various types of formulation, a reliable method of assessing dissolution in vivo and consequently analysing the rate of release of active ingredient(s) is required.

WO-A-9206680 is an example of an application relating to novel pharmaceutical formulations. In that disclosure dissolution testing is carried out using a method based upon the USP XXII dissolution test for tablets and capsules. This test is designed to subject the samples to an environment similar to that found in the intestine.

In that test a dissolution apparatus is used, again as specified by USP XXII. This essentially consists of a dissolution vessel into which is placed a buffered medium in which the dissolution testing of the pharmaceutical

formulation will be carried out. The sample is simply "dropped" into the medium and is allowed to float freely at the surface. The body of the medium is agitated by means of a paddle which is rotated. Paddle height is
5 adjusted so that the top edge of the blade is level with the surface of the liquid. Then, at various time points throughout the test, aliquots of the dissolution medium can be removed and replaced with fresh buffer. These aliquots can then be tested to determine the amount of
10 active ingredient(s) released from the sample formulation. This method is described in detail by Burns et al, *Int. J. Pharmaceutics* (1995) (in press).

There is, however, a problem with this adaptation of a
15 traditional type testing method, in that since the sample can float freely at the surface of the liquid it can in fact be caught up by the paddle and indeed the formulation under test could even stick to the paddle. Clearly, this may result in a delay in the breakdown of
20 the formulation, and hence release of active ingredient(s), by virtue of the reduced mechanical action of the paddle on an erodible formulation.

There thus exists a need to provide a dissolution testing
25 vessel which overcomes this problem and allows the dissolution testing to be carried out on pharmaceutical formulations without any mechanical interaction between the formulation and the means used to agitate the medium in which the testing is being carried out. There is also
30 required a means of assessing drug release from floating dosage forms without the sampling errors encountered when the dosage form is floating close to the surface of the dissolution medium.

Similarly, it would be useful to have dissolution testing apparatus which could be used to assess drug release reliably from a sinking, erodible, dosage form.

5 Thus, the present invention provides a dissolution testing vessel comprising means which prevent a formulation undergoing dissolution testing from floating freely at the surface of the testing medium, but which do not prevent the testing medium from moving freely within
10 the vessel.

In a preferred embodiment, the means will also prevent a formulation undergoing dissolution testing from sinking to the bottom of the testing medium.

15 The invention therefore provides a testing vessel which will prevent the mechanical interaction with the means of agitation described above. In particular, the testing vessel of the invention is suitable for testing
20 dissolution of both buoyant pharmaceutical formulations and sinking erodible dosage formulations.

Suitably, the means provided divide the vessel into at least two portions, while at the same time allowing the testing medium to move freely between those portions. In
25 a preferred embodiment of the invention the means consists of an insert, which is provided as a mesh or grille and typically will have substantially the same diameter as that of the inner wall of the vessel.
30 Suitably this can be made of stainless steel.

A particularly convenient way of allowing the insert to be held in place is to provide the vessel with one or more projections which project inwardly from the wall of

the vessel and on which the insert can rest.

Alternatively, a continuous projection can be provided which runs for substantially the whole of the inner
5 circumference of the vessel, eg a collar, ridge or shoulder. Thus, the insert can simply be dropped into the interior of the vessel and will sit on the collar, ridge or shoulder.

10 Suitably, the one or more projections, or continuous projection respectively, can be formed as part of the vessel itself. This is particularly the case if the vessel is made of plastic or glass.

15 Therefore, in use, the pharmaceutical formulation under test will remain below the insert (if it is a floating dosage form) and will not be free to float at the surface. If, however, it is a sinking erodible dosage
20 form, it can rest on the top of the insert. The medium itself is still agitated by means of a paddle or paddles and the normal aliquots can be taken at appropriate time points to determine the amount of active ingredient(s) released.

25 The mechanical interaction between the means, for example an insert, and the formulation, provides a suitable means of mechanical erosion, whether the dosage form is a floating type or sinking type, and therefore mimics the effect of the gastrointestinal tract in vivo. Unlike the
30 paddle set to surface method described by Burns et al, 1995 (supra), there is little tendency for the formulation to stick to the means.

A preferred embodiment of the invention (used to assess

a floating dosage form) will now be described with reference to the accompanying drawing in which:

Figure 1: is a sectional view of a preferred embodiment of the invention.

In Figure 1 can be seen a sectional view of a preferred vessel(1) of the invention. The vessel(1) is moulded with a continuous indentation(2) which runs along the entire circumference of the vessel. This effectively divides the vessel into a lower portion(3), which represents approximately one third of the vessel's volume, and an upper portion(4). The provision of the indentation means that there is also provided a shoulder or ridge(5) which runs for the whole of the internal circumference of the vessel(1). An insert(6) is simply dropped into the vessel(1) and will rest upon the shoulder or ridge(5). A pharmaceutical formulation undergoing testing will be placed in the vessel before the insert(6) is dropped in and once the testing medium has been poured into the vessel the pharmaceutical formulation will remain within the lower portion(3) of the vessel(1) and will be prevented from floating freely at the surface of the testing medium by the insert(6).

**EXAMPLE 1: Comparison of Modified and Existing
Dissolution**

A dissolution study was carried out with a floating dosage form, size '0' enteric-coated capsules containing a granule preparation of salmon calcitonin with a potency of 400 iu per capsule. The dissolution medium, volume 900 ml, was maintained at 37°C ± 1°C and contained 5.84 g.l⁻¹ disodium hydrogen orthophosphate, 4.61 g.l⁻¹

potassium dihydrogen orthophosphate, 2.00 g.l⁻¹ sodium
cholate and 1.00 g.l⁻¹ sodium deoxycholate adjusted to pH
6.8. To determine the release of salmon calcitonin from
the floating capsules, 5 ml samples of dissolution medium
5 were removed for analysis. Samples were removed at
specific intervals (eg 10, 15, 20, 25 min), up to 30 min,
in each case the volume being replaced with fresh
dissolution medium. The calcitonin content of the
samples was determined by a specific ELISA for salmon
10 calcitonin and quantified by comparison with authentic
standards.

The two dissolution methods compared were as follows:

15 METHOD A - BP Type II apparatus with the paddles set to
the surface of the dissolution medium as described by
Burns et al (1995), *Int. J. Pharm.* (in press);

METHOD B - the present invention.

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The paddle rotation speed in both cases was 100 rpm.

Results

25 The results of the study comparing the two dissolution
methods are shown in Table 1.

TABLE 1

Time (min)	Standard Method A	Present Invention B
0	0	0
10	<2	<2
15	2.5 $\pm$ 27 (>200)	22 $\pm$ 19 (95)
20	20 $\pm$ 32 (160)	54 $\pm$ 21 (39)
25	50 $\pm$ 24 (48)	82 $\pm$ 7 (9)
30	73 $\pm$ 2 (3)	90 $\pm$ 8 (9)

20 The values are means of 6 determinations $\pm$ SD, with the coefficient of variance shown in brackets, and are expressed as percentage salmon calcitonin released from the dosage form.

25 The results in Table 1 show that the extent and rate of calcitonin release from a floating dosage form is considerably less than using the method described in the present invention. Another observation is the reduced
30 variability in the measurements at each point with the present invention compared with the standard method illustrated by the lower coefficient of variance.

The skilled man will appreciate that any suitably shaped vessel can be used, of any suitable material. In
35 addition, the means provided with the vessel for preventing the pharmaceutical formulation from floating freely at the surface of the testing medium can simply be adapted to the vessel shape. All such variations are intended to be within the scope of the present invention.

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CLAIMS:

1. A dissolution testing vessel comprising means which prevent a formulation undergoing dissolution testing from floating freely at the surface of the testing medium, but which do not prevent the testing medium from moving freely within the vessel.
2. A dissolution testing vessel as claimed in claim 1 wherein the means comprises an insert.
3. A dissolution testing vessel as claimed in claim 2 wherein the insert has substantially the same diameter as the inner wall of the vessel.
4. A dissolution testing vessel as claimed in claim 2 or claim 3 wherein the insert consists of a mesh or grille.
5. A dissolution testing vessel as claimed in any one of claims 2 to 4 wherein the insert is made of stainless steel.
6. A dissolution testing vessel as claimed in any one of claims 1 to 5 wherein the vessel is provided with one or more projections projecting inwardly from the interior wall of the vessel.
7. A dissolution testing vessel as claimed in any one of claims 1 to 5 wherein the vessel is provided with a continuous projection, projecting inwardly from the interior wall of the vessel, which runs for substantially the whole of the inner circumference of the vessel.



8. A dissolution testing vessel as claimed in claim 6 or claim 7 wherein the one or more projections or continuous projection respectively are formed as part of the vessel itself.

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9. A dissolution testing vessel as claimed in any one of claims 1 to 8 which is constructed of glass or plastic.

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10. A dissolution testing vessel as claimed in claim 1 which is for use with pharmaceutical formulations.

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11. The use of a dissolution testing vessel as defined in any one of claims 1 to 10 in the dissolution testing of a pharmaceutical formulation.

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12. A dissolution testing vessel as claimed in claim 1 substantially as hereinbefore described with reference to the accompanying drawings.

