2007 International Nuclear Atlantic Conference - INAC 2007
Santos, SP, Brazil, September 30 to October 5, 2007
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: 978-85-99141-02-1

STABILITY EVALUATION OF BANDGEL LIKE HYDROGEL MEMBRANES

Ligia B. Panacho, Sizue O. Rogero, Ademar B. Lugão

Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP
lipanacho@msn.br, sorogero@ipen.br, ablugao@ipen.br

ABSTRACT

Stability study of four types of similar to BandGel hydrogels which were crosslinked by ionizing radiation were carried out according to Agência Nacional de Vigilância Sanitária (ANVISA). This kind of assay is used to evaluate the formulation stability in the research and development of life care products as hygiene and cosmetics. The stability study provides some indications of product behavior in intervals of time at submitted environmental conditions from the fabrication to finished product validate date. By the stability profile it is possible to evaluate the performance, security and efficacy as well the acceptability of the product by the consumer. It was used cycles of 24h stored in an incubator at 40 ± 2ºC and 24h stored in a refrigerator at 4 ± 2ºC, during 4 weeks. After each week it was analyzed gel fraction and swelling properties. The results showed good stability of all hydrogel types with similar gel fraction and swelling compared with samples soon after prepared.

1. INTRODUCTION

BandGel is a poly(vinyl pyrrolidone) (PVP) hydrogel membrane crosslinked by gamma radiation and to be used as wound dressing due to good properties as maintain moist environment, providing bacterial barrier, pain relief and allowing oxygen access to the injured area.

Polymeric hydrogel is a three dimensional network capable of absorbing and retaining great amounts of water or biological fluids.

The utilization of irradiation technique to produce hydrogel is being used increasingly around the world due to some advantages as no use of chemical crosslinker and in the same time is possible to obtain crosslinking and sterilization of the product (1-2).

The aim of the present work was to establish the technique to evaluate the formulation stability of PVP hydrogel membranes, and it was applied to four kinds of similar to BandGel PVP hydrogel membranes according to Agência Nacional de Vigilância Sanitária (3). The stability study provides some indications of product behavior in intervals of time at submitted environmental conditions from the fabrication to finished product validate date. By the

stability profile it is possible to evaluate the performance, security and efficacy as well the acceptability of the product by the consumer.

2. MATERIALS AND METHODS

2.1. Materials

The materials that had been used were PVP (polyvinyl pyrrolidone) K90 and PVP K30 from BASF, PEG (polyethylene glycol) from Oxiteno and agar from Oxoid.

2.2. Preparation of PVP hydrogels

Four different types of PVP hydrogel membranes had been prepared as described in Table 1. The agar aqueous solution heated to boiling was added to PVP or PVP + PEG solutions heated to 80°C. After cooling to about 45°C 5ml of the formulation was distributed in 60x15mm Petri dishes wrapped properly and sent to irradiation with gamma rays from 60-Co source at 20kGy dose.

Table 1. Different formulations of PVP hydrogels

Ingredients	Formulations			
	1	2	3	4
PVP K90	6%	5%	8%	2%
PVP K30	-	0,5%	0,5%	4%
PEG 300	1,5%	0,5%	-	-
Agar	0,5%	0,5%	0,5%	0,5%

2.3. Stability evaluation

The stability study provides some indications of product behavior in intervals of time at submitted environmental conditions from the fabrication to finished product validate date. It was used cycles of 24h stored in an incubator at 40 ± 2ºC and 24h stored in a refrigerator at 4 ± 2ºC, during 4 weeks. After each week it was removed a sample of each formulation to observe changes in aspects as color and smell and were analyzed gel fraction and swelling degree properties. The only visible change observed in the samples was loss of water. The characterization properties as gel fraction and swelling behavior were carried out with dried membrane in an oven at about 60°C, until constant weight.

2.4. Gel fraction

The gel fraction assay was carried out with samples 1, 2, 3 and 4 before and after stability assay. The hydrogel membranes had been oven dried at 60ºC, until constant weight and the

soluble fraction extraction was gotten in Sohxlet extractor with distilled water during 40 hours. After extraction the samples were oven dried again until constant weight and the gel fraction (G%) was calculated by the equation 1:

$$G\% = {W_g}/{W_0} \times 100 \qquad (1)$$

Where:

Wg is the dried gel weight after extraction.
W_0 is the initial weight of the sample

2.5. Degree of swelling

The dried hydrogel samples were immersed in 50mL of phosphate buffer solution (PBS) pH 7.4. The samples were removed from the solution and weighed in the first hour each 15 minutes, in the second hour each 30 minutes, each hour until the 8 hours and after 24 hours. The degree of swelling was determined according to the following equation (2):

$$S\% = \left[W_s - W_0 / W_s\right] \times 100 \qquad (2)$$

Where:

Ws and W_0 represent the weight of the sample after and prior to immersion respectively. All experiments were carried at room temperature.

3. RESULTS AND DISCUSSION

The four types of PVP hydrogel formulation showed good physical aspect after irradiation but formulation number 4 presented weaker when hand holding.
During stability test all hydrogel membranes showed water loss and the color and smell did not change.
The results of gel fraction are listed in Table 2. It can be seen, that the gel fraction decrease is very small as shown in Fig. 1.

Table 2. Results of gel fraction (% G ± sd) **of different PVP hydrogel formulations**

Stability evaluation time (weeks)	Formulations			
	1	2	3	4
0	91.5 ± 2.5	97.6 ± 2.2	98.2 ± 0.7	95.2 ± 0.5
1	92.4 ± 0.9	96.1 ± 1.5	97.5 ± 0.4	94.0 ± 0.3
2	88.5 ± 1.7	91.1 ± 0.9	95.5 ± 1.2	92.6 ± 1.8
3	87.7 ± 1.2	93.6 ± 1.0	95.7 ± 1.7	92.0 ± 1.2
4	85.8 ± 1.1	93.1 ± 1.8	94.6 ± 0.4	89.5 ± 0.8

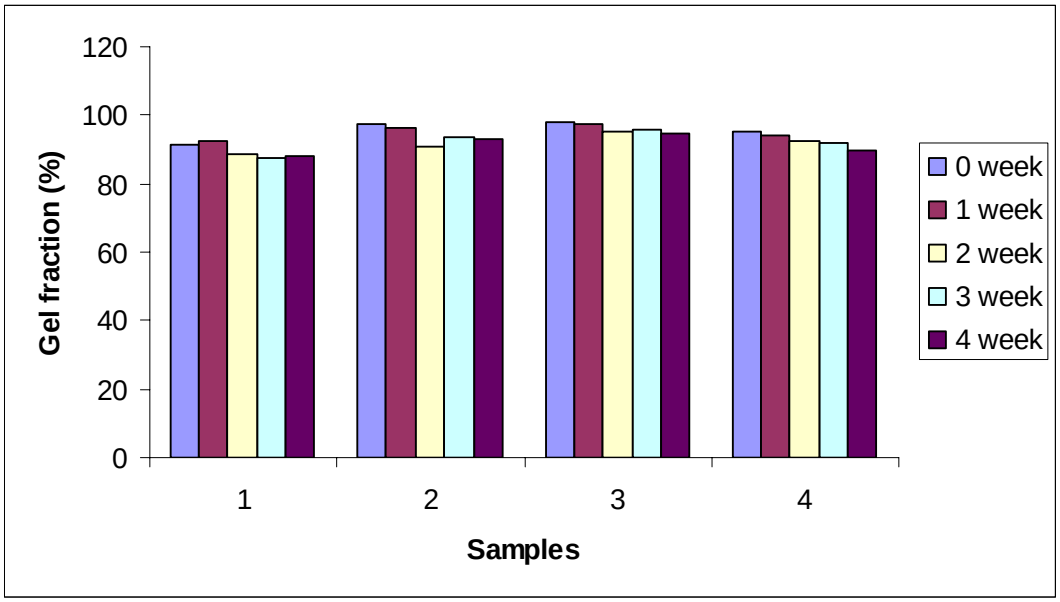

Figure 1. Gel Fraction of different PVP hydrogel like BandGel formulations during stability evaluation study

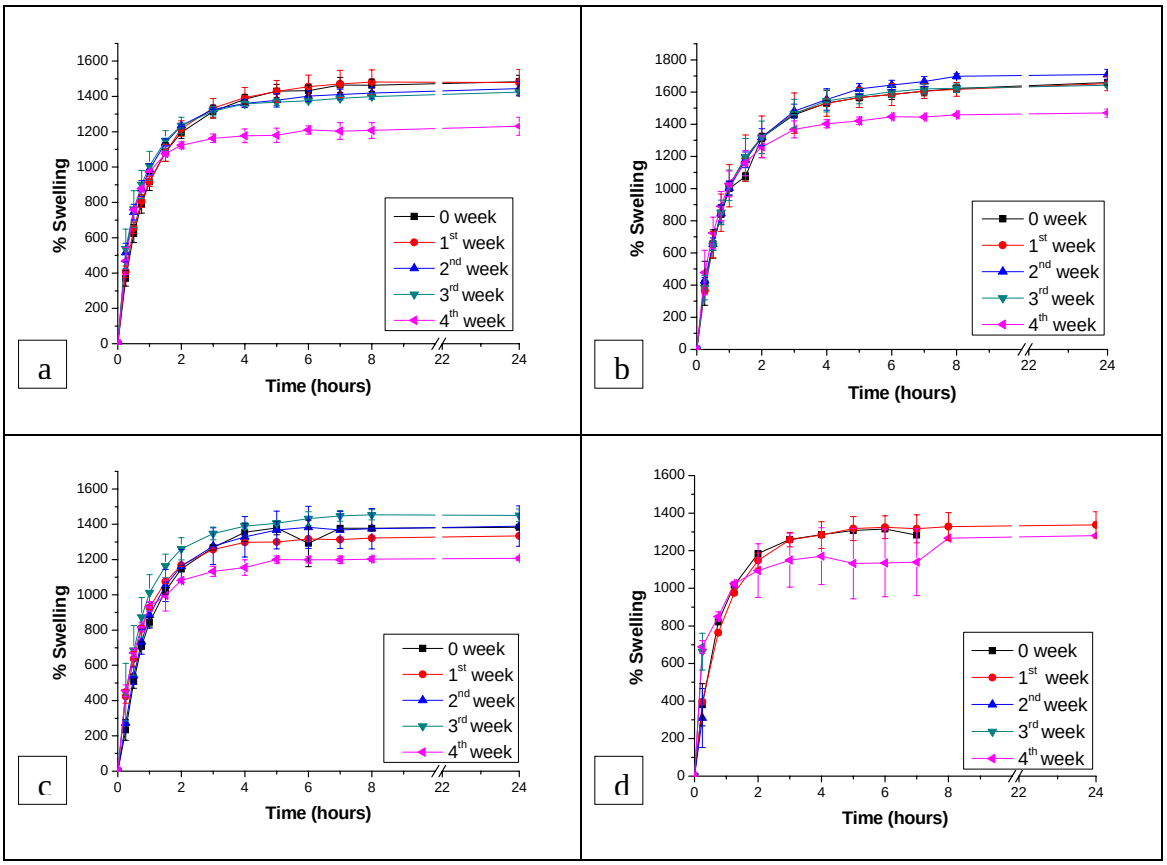

Figure 2. Swelling degree of different PVP hydrogel formulations during stability study: (a) formulation 1, (b) formulation 2, (c) formulation 3 and (d) formulation 4. (Swelling mean and standard deviation bar)

In the swelling assay the hydrogel formulations 1, 2 and 3 showed the same behavior in three weeks and the swelling degree in the fourth week was a little lower. The hydrogel formulation 4 presented no good stability in this study; the membranes broke in the swelling assay during the stability test. Based in the gel fraction and swelling degree it is possible to verify the formulation stability in a short time utilizing the methodology showed in this work.

4. CONCLUSIONS

According to Agência Nacional de Vigilância Sanitária (ANVISA) it was possible to establish the technique to evaluate the formulation stability of four types of similar to BandGel PVP hydrogel membranes. This kind of assay is used to evaluate the formulation stability in the research and development of life care products as hygiene and cosmetics and the results showed good stability of all hydrogel types with similar gel fraction and swelling behavior compared with samples soon after prepared.
This study is very important because with the stability profile it is possible to evaluate the performance, security and efficacy as well the acceptability of the product by the consumer.

ACKNOWLEDGMENTS

We acknowledge Embrarad by irradiation of samples and Sônia Corazza for scientific assintance.

REFERENCES

1. S.O. Rogero, O.Z. Higa, M.B. Mathor, L.D.B. Machado, A.B. Lugão, L.G.A. Silva. “Biocompatibility study for PVP wound dressing obtained in different conditions” *Radiat Phys Chem*, **55**, pp. 705-707 (1999).
2. D. Bloor, R.J. Brook, M.C. Flemings, S. Mahajan, *Hydrogels - The Encyclopedia of Advanced Materials*, vol.2, pp. 1060-1066 (1994).
3. *Guia da estabilidade de produtos cosméticos*. Agência Nacional de Vigilância Sanitária, 1. ed., Brasília: 2004.