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DESIGN OF MICRO-CAPSUL GELATIN-ACACIA COACERVATION DISPERSED IN SEAWATER

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ABSTRACT

One of the prawn rearing method had been using artificial feed of gelatin-acacia microcapsule. Characteristics of this microcapsule is very small and its size can be predicted and its density is as same as sea water.This study aimed to measure size distribution of fish oil droplet and the gelatin-acacia membrane was calculated in order to get the same density of sea water. Results of this study showed that design of microcapsules were effected by density of fish oil, membrane (coacervation of gelatin – acacia), droplet size, and density of sea water. The size distribution of fish oil droplet was presented and their variation of expected size and its actual size of microcapsule can be predicted for efficiency of the encapsulation process.

Keywords: design of microencapsulation, density, droplet size

INTRODUCTION

One of the chalenge of production of special nutrients content of marine animal, especially prawn was application of artificial diet nutrients needed for prawn growth but also benefit to human consumption of this product. The main delivery of nutrients to marine animal are using traditional diet made from microalga or tetraselmis used in rearing of prawn. The artificial diet for prawan had been applied using several methods such as micro gel, interfacial polymerization (nylon-protein microcapsule) and coacervation technique, lipid walled microcapsule (Okada *et al.* 1985) .

Coacervation was reported by Bongenberg de Joung in 1949 on polymer reaction between gelatin and gum acacia (Bungenberg de Jong 1949). In basic condition, gelatin charge was cation and gum acacia charge as union. While in acid condition, gelatin charge as cation and gum arabic as anion resulted in salth of gelatin and gum acacia and this salt separated form solution and setled on the surface of any particle in the solution (coacervate from Greek meaning coagulated) (Bungenberg de Yong 1949).

Microcapsule of marine anial having density must be allow the diet to be having bouyancy to allow the animal to contact with the diet. In animal having characteristics filter feeded the density of the diet must be ratetively the same as seawater. The model of coacervation of fish oil and gelatin-acacia membrae would be exaample of designing of feed for animal marine (Luzardo-Avares 2010).

Complex coacervation sistem of gelatin solution of 1% and acacia gum of 1% could be developed for encapsulation of bio-aactive materials. The system had been developed to mearured pH optimum of coacervate formation, coaservate recovery and viscosity and density

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of the solution sistem for predicting its membran thickness on covering the bio-active materials. Results showed that using turbidity measurement, pH of the sistem could recovery of the coacervate of the sistem was 3,5 and the dried coacervate recoveri was 81±4%. The mixture of gelatin solution of 1% and gum acacia solution of 1% were measured for density and viscosity and the results were 1,0876±0,0045 g/ml and 0,986±0,025 mPa.s, respectively. This physical characteristics could be used for calculating membran thichness for certain bio-active material to be coated (Sabitha *et al*. 2010).

MATERIAL AND METHODS

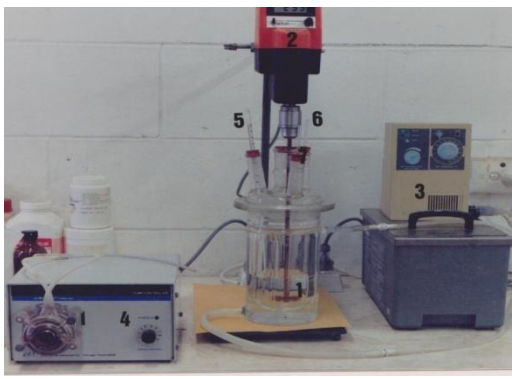
1. Material characteristics of coacervate

Based on coacervation experiment the system of gelatin and acacia of 1% restectively, the coacervate weight and density were as follows (Komari 2013).

Table 1. Optimum pH, Viscosity, weight and density of cioacervateof gelatin and gum acasia syetms.

No	Parameter	Value
1	pH optimum	3,5
2	Viscosity	0,986 ± 0,025 mPa.s
3	Weight of coacervate recoovery	81 ± 4 %
4	Density	1,0287± 0,0035 g/ml

Sources: Komari (2013)



Fibure 1. Experimental Set up of coacervation technique

2. Methods of Clculation of Density of Coacervation Particle

Based on density of sea water of 1.025g/ml, the microcapsule of oil can be beterminet and these values can be used to determined wight of oil and weight of coacervated. The assumtion of equal mass of gelet and gum acacis the each weght can be determined. The total density of microcapsule can be calculated and the total ratio of oil and coacervate material such as gelatin and acacis can be determined.

Volume of droplet surrounded by coacervate of gelatin-acacia can be calculated based on volume on droplet and volume of coacervate as shown in Figure 2.

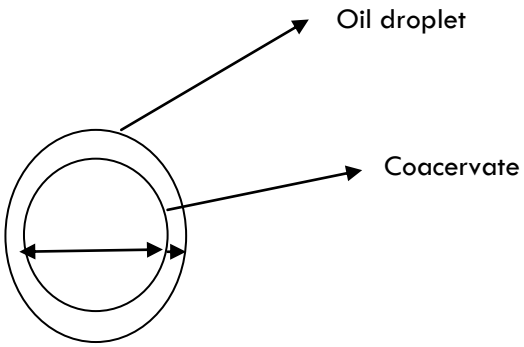
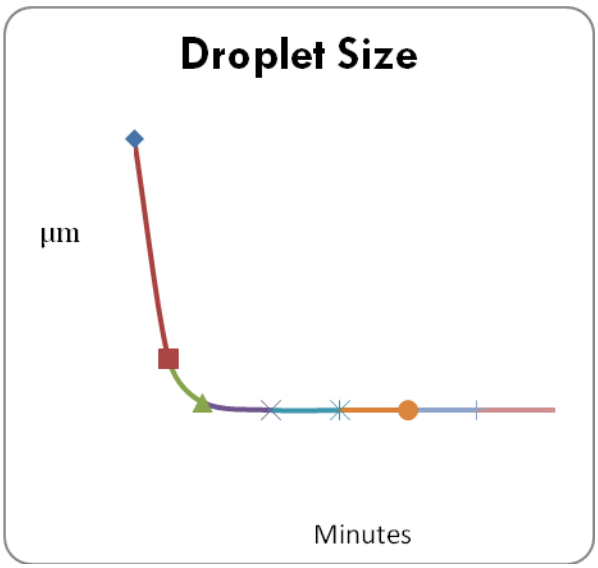


Figure 2. Model of Microcapsule of Coacertion Technique Systems

The volume of coacervate and droplet were calcuated using equation of $4/3\pi R^3$. The weight of droplet and coacervated can be found using its density and therefore its weight of oil and gelatin-acacia coacervated can be determined.

Predicted density of microcapsule of oil can be obtained using equation : Density of sea water = density of oil microcapsule; Since weight of microcapsule = weight of oil + weight of coacervate. Therefore, Volume of microcapsule x expected density of microcapsule = Volume oil x Density oil + Volume coacervate x density of coacervate. The oil fraction was measured during mixing of oil in gelatin acacia ratio of 1:1 and the minimum oil droplet size can be used asexpected droplet size to be coated with coacervate of gelatin and gum acacia. Size of microcapsule was measured using micrometer under micropcope of 200 droplet or microcapsules.

Since, in the coacervation system oil droplet was produced from 0,5 ml of oil, weight of coacervated was .0,45 gram. Based on size reduction of oil droplet during mixing in 200 ml at 40°C of galatn-gum acacia mixture at 1:1 the droplet size was 7 um since the microcapsule produced, the coted shloud be 7-10 µm.



Fihure 3. Droplet size uding mixing at 600 rpm, oil fraction 0,025

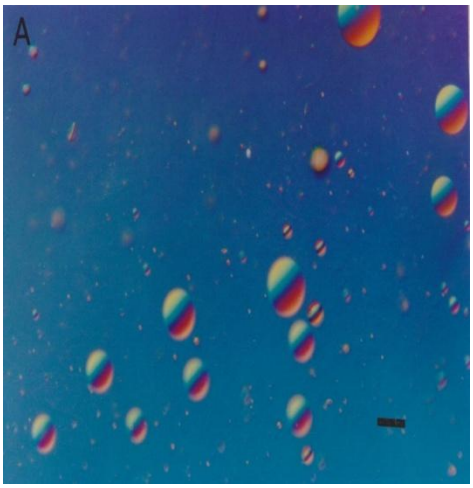


Figure 4. Droplet samples under microscope (mixing 600 rpm, 10 minutes)

This study found that the distribution of microcapsule would be:

Size Range of Microcapsule	Mass Fraction %
<5 µm	24.7 ± 1.2
5 -20 µm	49.6 ± 2.7
20 -50 µm	18.8 ± 0.6
>50 µm	6.0 ± 2.5

This phenmenon could be due to the agglomeration of the droplet during coating (Figure 5).

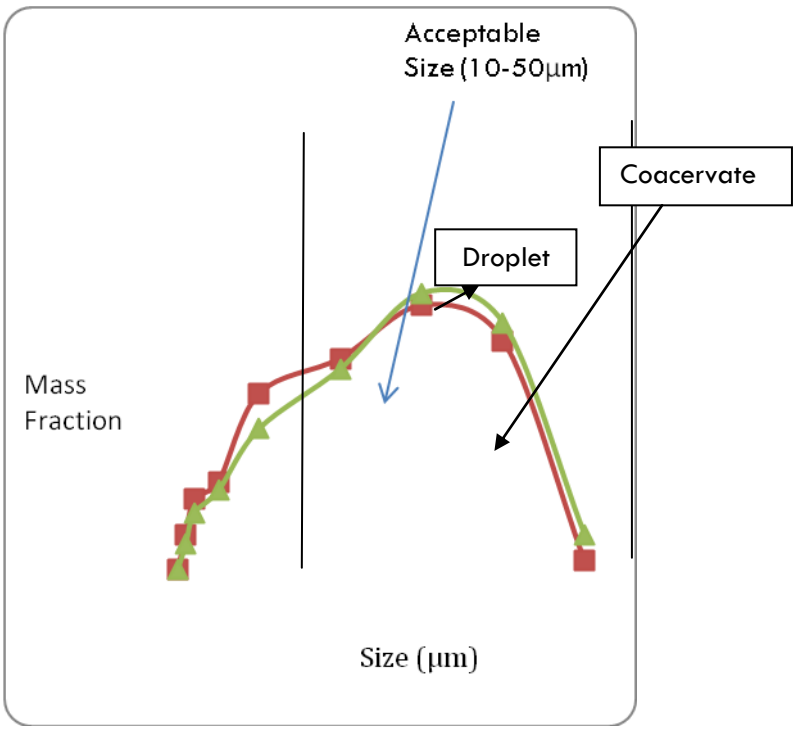


Figure 5. Size distribution of droplet and microcapsule

The thickness of microcapsule wall was measuren between 1-3 µm. The product of droplet and microcapsule were based on mass fraction of 49 % and 54% respectively (AppaRao *et al.* 2010).

RESULTS AND DISCUSSION

1. Measurement of microcapsule size

Micriocapsule of gelatin and gum acacia is conducted at pH 3,5 and temperature system of 40°C. The total coacervate was 0.81 of total both gelatain and gum acacia. This coacervate is than attaching surrounding on survace of oil droplet. The ratio of oil volume and weght of polimers would be calcculataed using numerical methods.(Figure 3 and Figure 5)

2. Microcapsule size

Microcapsule size can be detected using 200 microcapsule measured using micrometer of microscope and documented using computer. The microcapsule size dsitribution was also tested using bouyancy of the mirocaosule in seawaer and measured microcapsule size and its distri bution (Figure 6).

Based the data of dehydration of microcapsule, the changes in microcapsule size was due to aggregation of droplet. The less droplet aggregated the higher coacervate may affect the density of microcapsule and therefore, the higher of microcapsule was settleing down in the flask. Microcapsule and dehydrated microcapsule forr 3hour soaking in sea water the mass recovery were 50% and 49% respectively (Latheeshillal *et al*. 2013).

Microcapsule of oil droplet was then allowed for 3 hours to settle down and the particle was then remeasure and the result shown in Figure 7.

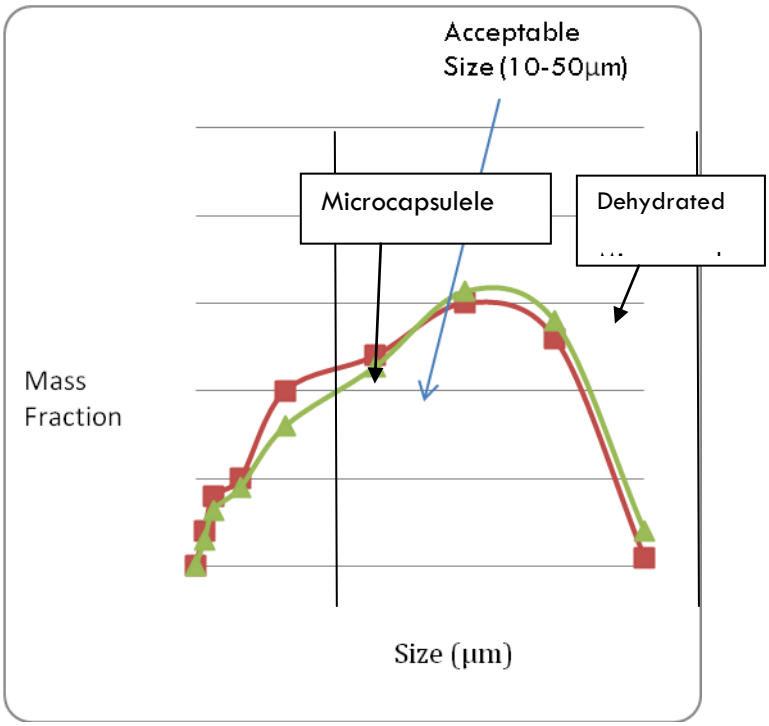


Figure 6. Size and dehydration of microcapsule

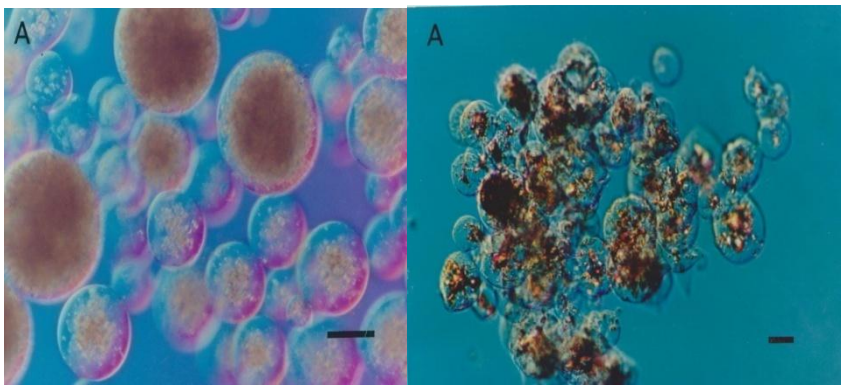


Figure 7. Wet microcapsule (left) and Dehydrated Microcapsule after 3 hours (Right)

Observation of coacervate to be in form of solid and more than 50 micron was 2.1% and 1.3% or (3.4%). Polimers in form of solution was 7 %, and 89.6% of microcapsule can be calculated. The effectiveness of these microcapsule size would be benefit to scale up of production.

CONCLUSION

Design of microcapsule was obtained using calculation of droplet size and cacervate mass attaching surrounding the droplet. Some coacervate could be in form of solid form or still in solution was about 7 %, the other would be 93% in form of microcapsule. The coacervate in form of solid was 2,1% and moser than 50micron was about 1,3%. The effectiveness of these microcapsule size would be benefit to scale up of production.

REFERENCES

AppaRao B, Shivalingam MR, Kishore R, Sunitha N, Jyothibasu T, Shyam T. 2010. Design and evaluation of sustained release microcapsules containing diclofenac sodium. *Int J Pharm Biomed Res* 1 (3) : 90-93

Bungenberg de Jong. H.G. 1949, Complex colloid systems. In H.R. Kruyt (ed) Colloid Sciemce Vol. II Reversible system. Elsevier, New York pp. 335-432Komari. 2013. Characterisation and fisical parameter of coacervation system of gelatin and gum acacia. *J. Farm. Indon.* (in press)

Latheeshjlal L, Satyanand S, Vaidya M. 2013. Design and In-Vitro Comparative studies of Glipizidies Microcapsules Prepared by Diffent Polymesr. *Int. J. Pharm. Pharmaceutical Sc.* 5 (4) 367-369

Luzardo-Avares A, Otero-Espinar FJ, Blanco-Mendez J. 2010. Microencapsulation diets and vaccines for culture fishes, crustaceans and bivalve molusks. *Int Drug Del Sci Tech.* 20 (4) 277-288

Okada J, Kusai A, Ueda S. 1985. Factors affecting microencapsulability in simple gelatin coacervation method. *J. Microencap.* 2(3): 163-173

Sabitha P, Ratna JV, Reddy KR. 2010. Design and evaluation of controlled release chitosan-calcium alginate microcapsules of tubercular drugs for oral use. *Int. J. Chem Tech Res.* 22(1) 88-98