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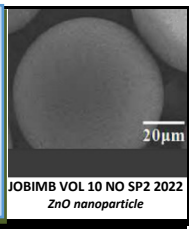

Study on Compact Powder Formulation from Fermented Rice Powder (Bedak Sejuk)

Nur Zafirah Aliah Baharuddin[1] and Noorhisham Tan Kofli[1]*

[1]Department of Chemical and Process Engineering,
Faculty of Engineering & Built Environment,
Universiti Kebangsaan Malaysia,
43600 Bangi, Selangor, Malaysia.

*Corresponding author:
Noorhisham Tan Kofli
Department of Chemical and Process Engineering,
Faculty of Engineering & Built Environment,
Universiti Kebangsaan Malaysia,
43600 Bangi, Selangor, Malaysia
Email: ntk@ukm.edu.my
Tel: +60123966379

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ABSTRACT

Bedak sejuk is a local cosmetic product produced from the natural fermentation of rice and can be placed in a group of green cosmetic products. Current traditional forms of production in beads require change for modern applications i.e. compact face powder. For that reason, the initial study was executed on the formulation to change it into compact powder based on three selected parameters which were bedak sejuk contents, binding agent concentrations (ethanol) and the amount of oil-absorbing agent (virgin coconut oil) used. Data obtained were analyzed using the One Factor At Time (OFAT) based on three tests which are drop test (height and weight) and its capacity to absorb oil. Based on the results, it is found that the best formulation for compact powder formulation (lowest cracking) was found at 50% bedak sejuk composition with 0.5 mol binding agent and 0.3 ml virgin coconut oil. This study indicates that bedak sejuk has the potential to be modernized for modern applications.

INTRODUCTION

According to National Pharmaceutical Regulatory Agency Malaysia (NPRA) annual statistics, in 2020 the number of applications for new cosmetic products increased by 111,820 compared to 2018 by 107,849. This sharp increase indicates that the demand for beauty products is growing rapidly in line with the changing time. However, this rapid growth has led to the accumulation of a large number of cosmetic products and raised public concern about the material used. They believed this large amount of cosmetic products might be harmful to their skin. Therefore, green cosmetic products are introduced where the material used is natural ingredients and few chemicals that are not harmful. Now natural cosmetics market growth and according to Bloomberg, it will be worth around USD 48 billion by 2025 [1].

Fermented rice powder (bedak sejuk) as one of the traditional green cosmetics for locals in Malaysia has been inherited through many generations. The usage of bedak sejuk is considered safe since its preparation solely depended on the natural ingredient (rice granules) which is allowed to ferment naturally by soaking the rice grains for several months to years until the rice turns into a wet powdery paste. The preparation very much depended on the makers resulting in a lack of standard preparation [2]. But there was a study done by Dzulfakar et al. [3] suggesting a standard preparation method by using water and rice ratio at 1:1 during the soaking process with the fermentation best occurring at a room temperature (25-27°C). It is also suggested that the soaking water is replaced every 14 days to refresh the process avoiding bad smells resulting from lactic acid bacteria during the fermentation [4, 5].

Often used by women as a midnight facial mask, it is believed that it gives a cooling effect to users as well as smoothens and whitens the skin. It is also reported, the powder is able to moisturize facial skin, shrink pores on the face, reduce acne problems and enhance the fresh impact on the facial skin [6]. This facial mask application is usually done by mixing the powder with a little amount of water and then applied to the face [1]. This type of application can be cumbersome and unattractive in a modern setting. Thus to modernize the application, the traditional forms of bead of bedak sejuk is changed into a modern setting in the form of compact powder.

This study aims at investigating the formulation of the compact powder by looking at the strength and durability as well as oil adsorption capacity using fermented rice powder as it based ingredient with the addition of binding agents.

MATERIALS AND METHODS

Bedak sejuk preparation

Local rice grains brand Jasmine Super Special (10-15% destroyed rice) were soaked with water at ratio 1:1 (w/v). The usage of higher destroyed rice content is to facilitate faster fermentation process which were done in a lid-covered container. The container was left at room temperature (25-27 ºC) for 14 days before the water being replaced to fresh water. These procedures were repeated six times until the soaking period completed after 84 days. The rice pastes were filtered and washed before undergoing the drying process (under the sun and in the oven).

Rice powder particles size

The dried powder paste (bedak sejuk) were crushed by using a mortar and pestle to ensure the powder before sieving it using 53 µm mesh Tyler screen. This step is to ensure the particle size of bedak sejuk used for compact powder preparation and formulation at a constant size range.

Compact powder formulation

The formulation used in this study is based on components listed in **Table 1** [7].

Table 1. Typical formulation of Compact Powder.

Chemical	Percentange (%)
Talcum (*bedak sejuk*)	55
Kaolin	20
Titanium dioxsida	5
Magnesium sterate	5
Zinc oxide	5
Ethanol	3
Polyvinyl alcohol	2
Virgin coconut oil (VCO)	5

Compact powder preparation

Compact powder samples (10 gm) were added into a container and pressed with 1 kg weight. The compact powder produced then dried in oven at 80ºC for 15 minutes before subjecting it into drop test (weight and height).

OFAT experiment design

For this experiments, the variations of parameters used are as follows based on the formulation in **Table 1**: concentrations of bedak sejuk (50%, 55% and 60%), ethanol (0.1, 0.3 and 0.5 mol) and VCO (0.1, 0.3 and 0.5 ml). The tests started with bedak sejuk contents, followed by ethanol and VCO concentrations. These resulted in experiments with different formulation using one factor at a time (OFAT) design as summarised in **Table 2**.

Table 2. Formulation compact powder.

Formulation	Percentage of content (%)							
	Bedak sejuk	Kaolin	Titanium dioxide	Zinc oxide	Magnesium stearate	Ethanol	Polyviny l alcohol	VCO
1	50	10	5	5	5	3	2	5
2	55	10	5	5	5	3	2	5
3	60	10	5	5	5	3	2	5
4	55	10	5	5	5	3	2	5
5	55	10	5	5	5	3	2	5
6	55	10	5	5	5	3	2	5
7	55	10	5	5	5	3	2	1
8	55	10	5	5	5	3	2	2
9	55	10	5	5	5	3	2	3

Strength & durability test

a) Drop Test by height and weight

The solid compact powder produced was tested by dropping it from 3 different heights ie 5 cm, 10 cm and 15 cm based on the industrial cosmetic test standard [8]. This step were repeated by different formulation compact powder. As for drop by weight, compact powder samples were subjected to 10 g, 20 g and 30 g weights at the same height of 10 cm. Each experiments were executed in triplicate and average data is collected.

b) Oil absorption capacity test

Compact powder sample (1 gm) was put inside a 25 ml beaker with addition of 10 ml of VCO. The solution were mixed using a magnetic stirrer at 1000 rpm for 5 minutes. After 5 minutes, the sample is centrifuged at 6000 rpm for 30 minutes. The supernatant was removed and transferred into 10 ml of measuring cylinder. This oil absorption capacity is calculated using the formula.

$$\text{Oil absorption capacity } \left(\frac{g}{g}\right) = \frac{\text{volume of oil absorbed } (m^3) \text{x density } \left(\frac{g}{m^3}\right)}{\text{mass of sample used } (g)}$$

RESULTS AND DISCUSSION

Soaking/fermentation of rice

During the soaking process, it was observed that a white layer was formed on the surface of the water and thickens as its reached day 14th. The colour of the soaking water turned to yellowish and murkier (**Fig. 1**) and emitted an unpleasant odour. These phenomena occurred due to growth of microorganisms during the natural fermentation process. This unpleasant pungent odour might be contributed by lactic acid bacteria (LAB) as its used rice as carbon source and release gas hydrogen sulphide [9]. The pH profile for 14 days in **Fig. 2** indicated the accumulation of acids during this process.

Fig. 1. Soaking/fermentation process.

From the graph, it can be said that the accumulation of bacteria started on day 3 as pH value drop from 7 to 3. The accumulation is part of natural fermentations that occur in the soaking process that resulted in decreasing in pH [10] and has no effect on the degradation of rice granules and structural properties of rice starch [11].

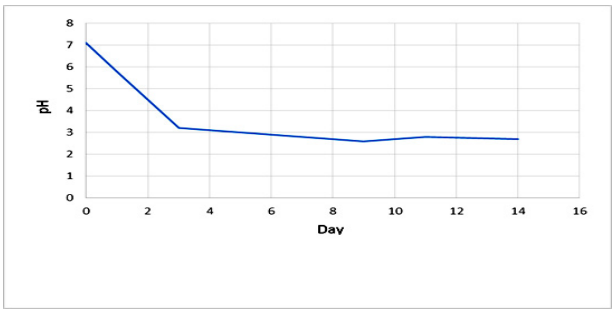

Fig. 2. pH profile during soaking/fermentation process of rice (14 days period).

Drop test

a) Height

Visual observation of the breakage on the compact powder tested were summarised at **Table 3**. Note below are the scale used to rate the breakage.

Table 3. Visual observation on compact powder breakage at different heights.

Formulation	Height		
	5 cm	10 cm	15 cm
1	O O +	+ + +	+ + +
2	O + O	+ + +	++ + ++
3	+ ++ +	++ + ++	+ ++ +++
4	O O +	+ + +	++ ++ +++
5	O + O	+ + +	++ + ++
6	O O O	+ + +	+ + +
7	+ + +	++ + +	+ ++ +++
8	O + +	++ + +	+ ++ ++
9	O + O	O + +	+ ++ +

Note: Breakage symbol/scale
O = No breakage (1)
+ = Lines of crack can be observed (2)
++ = Break into large pieces (3)
+++ = Break into medium pieces (4)
++++ = Break into small pieces (5)

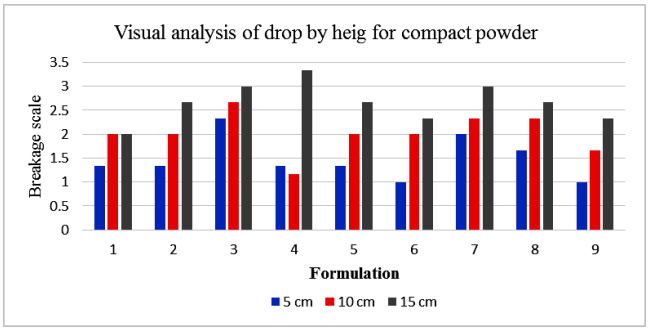

Fig. 3. Result of visual analysis of drop by height test.

The plotted graph in **Fig. 3** depicted the analysis of breakage on different formulation. It is found that formulation at 50% bedak sejuk powder, 0.5 mol ethanol and 0.3 ml VCO gave the lowest breakage scale.

b) Weight

The results obtained for drop by weight test are listed in **Table** 4 and **Fig. 4**. It also observed that formulation with 50% bedak sejuk content is found to give the highest in term on strength of the compact powder.

Table 4. Visual observations on compact powder breakage at different weights.

Formulation	Weight		
	10 g	20 g	30 g
1	O O +	+ + +	+ ++ +
2	+ + ++	+ ++ +++	++ + +++
3	+ + ++	+ ++ +++	+ ++++ ++++
4	+ + +	+ + ++	++ + ++
5	+ + ++	+ ++ +++	++ + +++
6	+ + +	+ + ++	+ + ++
7	+ + +	++ ++ +	++ ++ +++
8	+ + +	++ ++ +	+ +++ +++
9	O O +	+ + ++	+ ++ +++

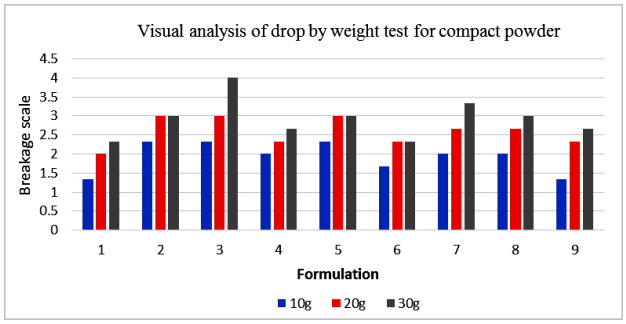

Fig. 4. Visual observation of drop by weight test.

All the data obtained from both drop test by weights and heights shows similar pattern with 50% bedak sejuk content resulted in good strength as suggested by the study of Jarupinthusophon and Anurukvorakun [12] which reported the higher content of flour used the greater the strength of the compact powder. The strength is believed to be contributed by the alkaline bonding between flour particles.

The surface of starch granules also changes as days of soaking increase making it easy to adhere to each other [10]. This indicates that bedak sejuk is suitable to be used as a material in compact powder formulations. The usage of higher concentration of ethanol as binding agent in the formulation also give better strength [13]. Ethanol is said to help forming the lattice structure between particles when the powder is compacted [14]. These results also correspond with study by Ping & Noorhisham [2] suggesting any alcohol and polivynyl alcohol are suitable binding agents for compact powder formulation. The usage of VCO also facilitate better strength as its contained higher lauric acid (45-54%) which help the bond between particles [15]. Lauric acids also has the strong polarity which can increase the bonding with water on the surface. During drying process, higher polarity of lauric acid will create attraction between molecules and tighten the molecules inside the compact powder that give the strength in result [16].

Oil absorption capacity test

As for oil absorption capacity test, the results are shown in **Table** 5 which correspond to formulation 7, 8 and 9 (in **Table** 2) and also presented in **Fig. 5**.

Table 5. Oil absorption capacity.

Formulation	Percentage of VCO (%)	Volume of supernatant (mL)	Volume of oil absorbed (mL)	Oil absoprion capacity (g/g)
7	1	8.7	1.3	1.131
8	2	8.6	1.4	1.218
9	3	8.5	1.5	1.305

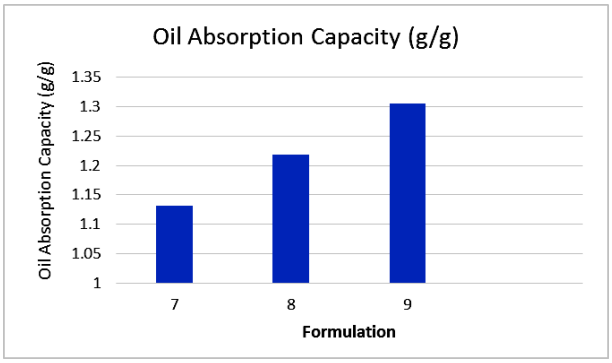

Fig. 5. Analysis Oil Absorption Capacity (g/g).

Based on the **Fig.** 5 the highest oil absorption capacity obtained using formulation 9 when highest volume of VCO used proving its potential to be candidate as oil adsorption agent. VCO is reported as contains 60% medium chain fatty acids (6-12 carbons) and also long fatty acids (14-16 carbons) as well rich in various fatty acids such as lauric acid (45-52%) and myristic acid (17-20%) respectively [17, 18]. These fatty acids are very helpful for skins and common ingredients for skin care and cosmetics because of its antioxidant properties, helping to generate epidermal lipid barrier to blocking moisture loss from skin [19].

CONCLUSION

From the study it is suggested that bedak sejuk can be changed into modern forms of compact powder from its traditional bead forms using the right formulation combination. The compact formulation of 50% bedak sejuk, 0.5 mol ethanol and 0.3 ml VCO showed the best in strength, durability and oil adsorption capacity.

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