Study of seaweed powder processing parameters using dry mill blender

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ABSTRACT – The aim of the study is to determine the factor that most influence the seaweed powder size when mill using dry mill blender. Three parameters used in this experiment were blending time, raw material treatment and mill speed. Weight percentage of milled seaweed powder of less than 250 micron were sieved and determined. It was found only temperature treatment of raw seaweed significantly influenced the weight percentage of seaweed powder produced. This is confirmed by ANOVA where the p-value of treatment temperature is 0.0058. The two other factors were insignificant. The final mathematical expressions for accepted powder can be written as Powder Accepted = - 0.52869 + (0.023435) * (Seaweed Treatment Temperature).

1. INTRODUCTION

Malaysia, especially Sabah, is a maritime state with more than three-quarters of its borders adjacent to the sea. Previous study showed seaweeds are algae categorized by pigment [1]. Seaweeds have historically been used as food, forage, fertilizer and medicines. They have value as nutrient ingredients in a wide range of prepared foods or as fresh or dried vegetables as previously study [2].

Spray drying has had limited use for organics product in the past because of the high temperatures used during the process which would generate high viability losses. The inlet air can typically be at 120–160 ° C, and 50–80 ° C at the outlet which typically may damage the nutrient in seaweed as previously study [3]. Dry milling can reduce the wastewater and energy consumption to a minimum and the process is better in retaining product nutrient compared to wet milling [4]. Jetranut et.al. reported that wet milling of starch material significantly reduced it's nutrient content and alter it's physicochemical properties [5]. The aim of this study is to look into dry mill blender as an alternative process to produce seaweed powder. Applying optimum process parameters may produce a favourable result. The study also will determine the parameters which most influence the production amount of acceptable seaweed powder size.

2. METHODOLOGY

Experiment was design using the two-factorial method with the assistant of Design Expert 6.0 as shown in Table 1. The control factors were blending time, raw material treatment temperature and mill speed with the powder seaweed weight as it's response output.

The raw seaweed were initially cut into smaller pieces and then dried in an oven at 28°C and 175°C for 20 minutes. Ten grams from each batch of dried seaweed were than milled at 50-60 Hz with blending time of 30-60 seconds.

Table 1 Design of experiment using Design Expert.

Blending Time (s)	Seaweed treatment temperature (^{O}C)	Mill Speed (Hz)
60.00	175.00	50.00
30.00	28.00	50.00
30.00	175.00	60.00
30.00	28.00	60.00
60.00	28.00	50.00
30.00	175.00	50.00
60.00	28.00	60.00
60.00	175.00	60.00

The milled seaweed were than sieved using the 250 micron size seiver and weight using the digital weighing scale.

3. RESULTS AND DISCUSSIONS

Results of the experiment are shown in Table 2. The normal plot of residuals in Figure 1 obtained from Design Expert data analysis showed a significance "S" shape curve which may indicate a bimodal distribution. The bimodal distribution of the experimental data may point out the results may have two symmetrical normal curves.

Table 2 Weight percentage of 250-micron seaweed powder size obtained

Blending Time (s)	Seaweed treatment temp. (^{O}C)	Mill Speed (Hz)	Response Powder Size (%)
60.00	175.00	50.00	54.1
30.00	28.00	50.00	0.5
30.00	175.00	60.00	40.9
30.00	28.00	60.00	0.9
60.00	28.00	50.00	1.5
30.00	175.00	50.00	14.7
60.00	28.00	60.00	2.2
60.00	175.00	60.00	33.2

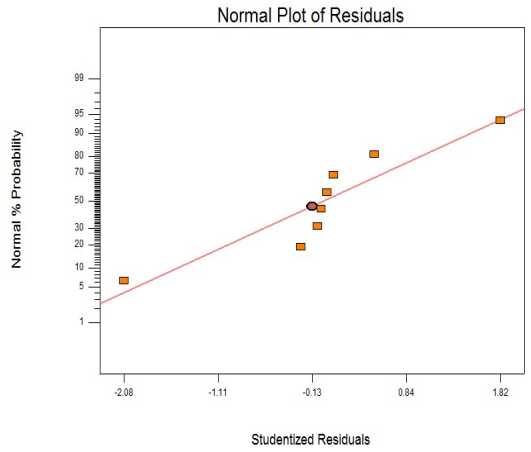

Figure 1 Normal Plot Residuals

The highest percentage of acceptable seaweed powder produced was at 60s blending time, 175ºC treatment temperature and 50Hz of mill speed. It is observed in Table 2, all seaweed treatment temperature at 175ºC showed in the range of 10-55% in weight of acceptable powder size. This is also in agreement with the ANOVA results which showed the temperature factor is the only with p-value <0.05. The other two factors, blending time and mill speed are insignificant.

Naturally, raw seaweed showed an hydrophilic like behavior due to it's polysaccharide molecules [6] . The higher drying temperature may have removed more moisture which is observed by it's brittleness character compared to the lower treatment temperature. This may have boost up the process of crunching and pulverizing it into fine powder. This also signifies the importance of storing the raw seaweed in a dry environment in order to reduce moisture presence before processing which will significantly increase milling time and temperature to obtain the desired powder size. The results also showed that the mill speed and blending time were inadequate to affect the powder formation process. Future study may expand the scope to higher mill speed motor and alternative reinforced mill blade material.

4. CONCLUSIONS

It is shown that treatment temperature play the most important role in the formation of seaweed powder using dry mill blender. Using two factorials design of experiment the mathematical expressions for the Seaweed powder accepted can be written as Powder Accepted = - 0.52869 + (0.023435) * (Seaweed Treatment Temperature).

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