FORMULATION OPTIMIZATION USING RESPONSE SURFACE METHODOLOGY (RSM) ON SUCROSE-FREE HARD CANDY WITH JAVANESE LONG PEPPER (Piper retrofractum Vahl.) SUPPLEMENTATION

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Introduction

Conventional “hard candy”

Problems:

- High content of “sugar”
- Risk of dental carries dan other health issues

Alternative:

- Sugar partial replacement by xylitol
- Hard candy with lower “conventional sweetener”
- Enrichment with “herbal ingredient”

Javanese long pepper
(*Piper retrofractum* Vahl.)

Objectives of the study:

Investigating the effects of formulation (xylitol and Javanese long pepper extract) on characteristics of hard candy and suggesting the optimum formulation.

Method

Experimental Design

Build information:

- File version: Design Expert 13 (trial version)
- Study type: Response Surface
- Design type: I-optimal
- Runs: 16

Based on preliminary experiment / trials

Factor	Unit	Minimum	Maximum	Response
Xylitol (A)	g	10	30	Antioxidant (%); Solubility time (min); pH; RGB color
Javanese long pepper extract (B)	g	5	10	

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Method

Sample Preparation

Mixing and stirring
glucose (70 g), water (10 g), xylitol (10-30 g)

Heating (up to 140 C)

Mixing and stirring
added with the extracts (5-10 g)
and citric acid (2 g)

Heating.
Terminated at 140 C

Pouring and forming
Immediately poured into forming plate

Sample storage
Hard candy is stored for further analysis

Results & Discussion

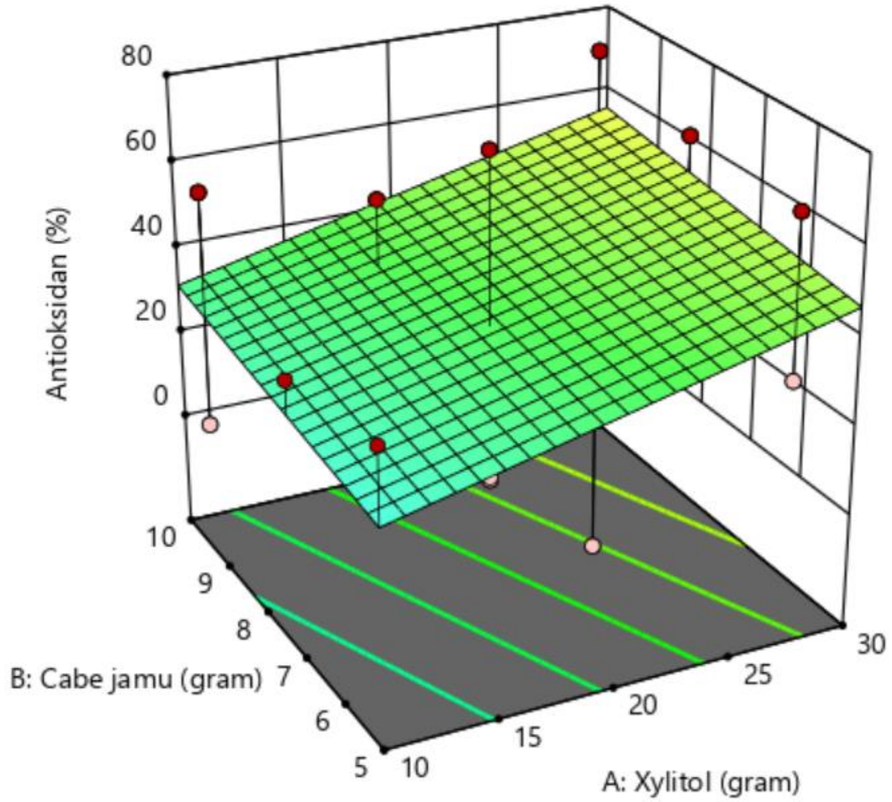
Appearance of 16 Samples

Colors of samples differed greatly.

Results & Discussion

Effects on Antioxidant

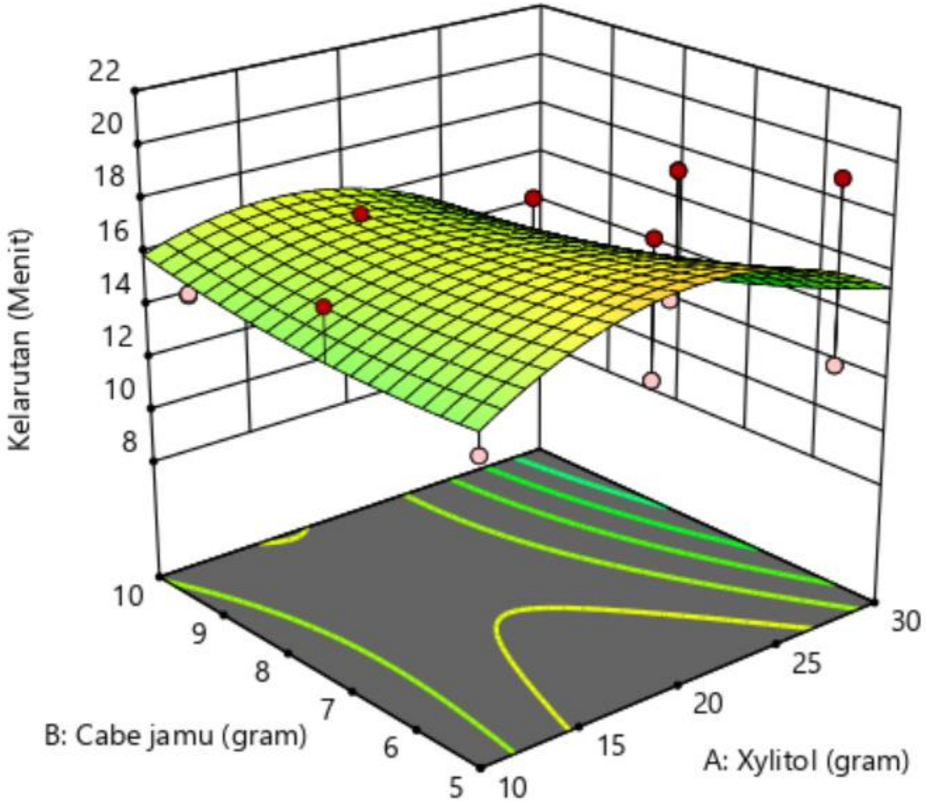
- Antioxidant activity is expressed as percentage of radical inhibition
- Based on DPPH assay
- Antioxidant is presented in a linear model
- Higher Javanese long pepper extract and xylitol appears to increase antioxidant activity



Results & Discussion

Effects on Solubility Time

- Solubility time is expressed as the amount of time (min) required to dissolve sample (2 g) on simulated condition (continuous stirring in distilled water at 30 C)
- Solubility time is presented in a quadratic model
- Javanese long pepper extract contributes to the response differently, depending on concentration
- Xylitol appears to increase solubility time at certain level.



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Results & Discussion

Effects on PH and RGB color

- pH and RGB color are recommended to express as mean
- Both data are insufficient to produce model
- The level of pH ranges 2.9 – 3.4, which might result from the addition of citric acid
- RGB color ranged 38 – 177, showing high a variety of color.

Results & Discussion

Optimization & Verification

Constraints

Name	Goal	Importance
A: Xylitol	is in range	3
B: Extract	is in range	3
Antioxidant	maximize	4
Solubility time	minimize	3
pH	is in range	3
RGB color	minimize	3

Desirability

Xylitol (g)	Extract (g)	R1 (%)	R2 (min)	R3	R4	Desirability
30.000	**10.000**	**55.718**	**12.073**	**3.228**	**60.821**	**0.746**
30.000	9.721	55.230	12.165	3.228	60.821	0.741
30.000	9.017	54.004	12.449	3.228	60.821	0.726
10.000	8.938	29.625	15.478	3.228	60.821	0.487
10.000	8.898	29.556	15.463	3.228	60.821	0.487
10.002	8.982	29.705	15.495	3.228	60.821	0.487

The suggested solution was verified, resulting in antioxidant 42.4% (R1), solubility time 14 min (R2), pH 4.3 (R3), and RGB color 58.53 (R4).

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Conclusion

Finding and Further Works

Finding

Formulation successfully produced hard candy with supplementation of xylitol and Javanese long pepper extract. Based on the experiment, the optimum condition was achieved by xylitol 30 g and the extract 10 g, yielding the characteristics of hard candy as follows: antioxidant 42.4%, solubility time 14 min, pH 4.3, and RGB color 58.53.

Further works:

- Improved model for more reliable prediction of the response
- The use of more various polyols as sweetener alternative to conventional sugar.

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