

Comparison of physical properties of extemporaneous oral suspension with suspending agent pulvis gummi and xanthan gum using paracetamol as model drug

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Abstract. Contemporary paracetamol suspensions are made because some drug-active substances have a solubility that is practically insoluble in water but is needed in liquid form. Suspending agent is required to increase the low viscosity to prevent cake. Therefore, knowledge is needed about the ratio of PGA and xanthan gum as a suspending agent that can increase viscosity and the suspension's stability. The desired physical properties are that the suspension has particles that do not settle quickly and are easily redispersed. The study compared the physical properties produced by suspending agents PGA and xanthan gum. This research used an experimental method with descriptive data processing. In the study, six formulas were made to observe the appearance, color, smell and taste, pH value, particle size, and sedimentation volume formed, and the dispersibility of each formula was tested. Based on the study's results, it is known that the viscosity of the suspension with PGA has a higher value than that of Xanthan Gum. This is due to the ability of sedimentation volume and dispersibility time, which is faster because it has a larger particle size.

1 Introduction

The extemporaneous oral suspension is a preparation containing liquid particles congested and dispersed in a liquid, formulated and administered quickly, as per the recipe doctor. Excess central suspension This is flexibility in adapting dosage and formulation to the needs of patients, especially for children or patients with difficulty swallowing the tablet [1]. The primary constraint of the extemporaneous suspension is its stability and physical and chemical limitations, so it needs to be guarded with an influential agent suspension like Pulvis Gummi Arabic (PGA) and Xanthan Gum (XG). Agent suspension helps maintain particle dispersion and prevent deposition, making giving a consistent and effective dosage easier.

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Pulvis Gummi Arabic, also known as gum Arabic, is a polysaccharide effective as an agent suspension because it increases the viscosity and stability of physical suspension. Easy PGA is late in water and does not change conformation molecule medicine, making it ideal for guarding suspended particles with an excellent and easily dispersed return. Xanthan Gum is an anionic polysaccharide produced by the bacteria *Xanthomonas campestris* [2]. It is known because it forms a structured network like a gel, is stable in suspension, but quickly breaks and flows when shaken.

Character physical extemporaneous oral suspension is critical for ensuring effectiveness and safety preparations, which include size, particle size, and size. This is to guard stability suspension and ensure even distribution when consumed. Sufficient viscosity is tall enough to prevent the deposition of fast particles but still low enough to allow flow and give easy dosing. Redispersibility particles must be easily dispersed and returned after shuffling, ensuring consistent dosage each time they are used and the appropriate pH with a safe and stable range for medicinal purposes and comfort for the patient [3, 4].

Studies This aim is to evaluate the physical character of prepared extemporaneous oral suspension using the suspending agents Pulvis Gummi Arabic and Xanthan gum. Our study in line with one of the agenda of Sustainable Development Goals (SDG's) were to ensure healthy lives and promote well-being for all, at all ages.

2 Material and Methods

Table 1. Formulation of Paracetamol Suspense

Ingredients	Concentration	Function
Paracetamol	2.4g	Active ingredients
PGA	5-10%	Suspending agent
Xanthan Gum	0.2-0.25%	Suspending agent
Sodium Benzoate	0.1g	Preservative
Surplus	100 ml	Fluid carrier

2.1 Materials

Materials and tools used: optical microscope (Olympus®), viscometer Rheosys®, space cooling (Mettler®), tube reaction (Pyrex®), rack tube, mortar, stamper, glass measuring (Pyrex®), scales analytical (Ohaus®), and stem stirrer (Pyrex®). Formulation This is made of tablets Sanmol® (PT. Sanbe), Sirplus® (PT. Meprofarm), Xanthan Gum (Brataco), Pulvis Gummi Arabic (PGA) (Brataco), and sodium benzoate (Brataco).

2.2 Methods

2.2.1 Suspension formulating

Weigh the material to be used and place it in the container. Before mixing paracetamol tablets with sodium benzoate, use mortar. Mix both, then stir all material until smooth (mixture 1). Part surplus® was added to Xanthan gum and mixed with mortar until mucilage formed. Add surplus® until the sign limit. Add the Xanthan gum solution to combine 1. This is also done for the suspending agent PGA. Then, the suspension was entered into a container, which was tested for stability and Physical. This includes organoleptic tests, pH, viscosity, sedimentation, size particles, and dispersibility.

2.2.2 Organoleptic

The organoleptic test aims to know the color, smell, and taste of prepared suspension paracetamol so you can see that the condition of the suspension is still good. This matter is done by observing the color, taste, and smell suspension of paracetamol [5].

2.2.3 pH

pH testing is carried out using a digital pH meter tool. Previously, the pH meter was calibrated with the method entered to a pH 4 buffer because preparations to be made are in the pH range of 5.0-7.0 [6].

2.2.4 Viscosity

Tools used in viscosity tests is a Rheosys[®] viscometer. The test fluid is placed in a bowl, the rotor is installed, and then the instrument is turned on To measure viscosity. Press knob *power*, then observe measurement viscometer with see position *spindle* rotates perfectly and needle pointer in accordance number *spindle*, until in condition stable. Observation result seen use application Rheosys micra.

2.2.5 Sedimentation volume

Suspension was poured into the tube reaction, and 20 ml was closed with plastic. Then, it was placed on a free surface vibration and left to settle. The sediment volume (Hu) was recorded each time according to sampling [7].

$$F = Hu/Ho \dots\dots\dots(1)$$

Description: F = Sedimentation volume; Hu = Final height precipitate; Ho = Initial height suspension

2.2.6 Size particle

A microscope is used for the do test. To measure the diameter of the particles, preparations are calibrated with a ruler μm . The particle size is taken randomly, with 1-2 drops of suspension put on the object glass, and then the lens objective is lowered until the particle can be observed clearly. A size box scale determines the size of the particle. The particles between 100 and 500 are counted to get accurate data [8].

$$mA = \frac{\sum nd}{\sum n} \dots\dots\dots(2)$$

Description: mA = Size particle; d = Middle-value size particle; n = Number particle

2.2.7 Redispersibility

A dispersibility test was done with a rotating tool at 360° at a speed of 20 rpm, and the time required for precipitate return dispersed was noted. The study of dispersibility aims to determine how long the sediment lasts. Can disperse return.

2.3 Data Analysis

The data analysis includes Organoleptic, viscosity, sedimentation, dispersibility, and size test particles. Pay attention to his physical characteristics on days 1, 14, and 28 of each formula. Method Oneway Anova was used To analyze this formula data using SPSS. First, normality was tested with testing Shapiro Wilk's normality. It is testing. This is done with a sample size below 100. If its significance is more than 0.05, then the data is distributed normally, and because There are more from two data groups, the homogeneity test is done using Levene. After that, the test Oneway Anova did. The result shows that the difference is not significant. The difference is significant if the significance is more than or the same as 0.05. Suppose the value is not enough from 0.05. Tukey HSD Post Hoc Test can used to see more big differences.

3 Results and Discussion

Table 2. Visual observation results for 28 days

Formula	PGA (g)	Xanthane Gum (g)	Color	Smell and Flavor
F1	5	-	Orange	Sweet orange
F2	7.5	-	Orange	Sweet orange
F3	10	-	Orange	Sweet orange
F4	-	0.2	Orange	Sweet orange
F5	-	0.25	Orange	Sweet orange
F6	-	0.3	Orange	Sweet orange

A stable suspension should remain homogeneous, its particles should be well distributed in the liquid, the distributed substances should be smooth and not precipitate quickly, and the precipitate should redistribute quickly when mixed [9].

Observation of appearance, color, smell, and taste is carried out to know the differences between each formula. On storage until Day 28, it shows stable results in an organoleptic way (Table 2). There is a significant change in color, appearance, and odor. That can happen because the formula contains sodium benzoate, which is stable and soluble in water. Mechanisms work with bother cell microbes due to cell pH microbes always being neutral [6]. If cell microbes become sour or base, cell organs will disturbed, hindered metabolism cell, and finally, part of the cell will die. Orange essence was added. For repair, the taste of the suspension was bitter, and the color was more interesting.

Table 3. Observation of the physical properties of the suspension

Formula	pH			Viscosity (cPs)			Sedimentation (F)			Size particles (µm)			Resdispers (sec)		
	1	14	28	1	14	28	1	14	28	1	14	28	1	14	28
F1	5.46	5.52	5.53	73.48	69.18	70.12	0.06	0.09	0.09	3.25	3.30	3.25	27	41	54
F2	5.29	5.31	5.35	110.09	102.75	113.09	0.08	0.10	0.10	3.30	3.25	3.20	45	90	100
F3	5.20	5.23	5.25	158.22	153.49	155.73	0.08	0.11	0.10	3.20	3.20	3.20	67	112	125
F4	6.44	6.48	6.41	87.10	89.54	88.25	1	0.07	0.08	3.25	3.23	3.15	-	36	37.67
F5	6.46	6.43	6.42	92.05	91.68	92.04	1	0.06	0.06	3.23	3.20	3.12	1	37	40.22
F6	6.48	6.44	6.40	96.29	95.20	95.32	1	1	1	3.08	3.08	3.05	-	-	-

A suspending agent was added to increase stability and physical suspension because the frequent problems in suspension are speed, high sedimentation, and capability poor dispersibility. Suspension with PGA has a range pH value of 5 by characteristic Pulvis Gummi Arabicum (PGA) viz nature sour, can soluble in water, and not be dissolved in alcohol. In contrast, suspensions containing xanthan gum tend to approach neutral. To prevent particle settlement, a suspending agent is needed to thicken the suspension based on the results, suspension research with PGA has marked higher viscosity than xanthan gum. That matters because PGA is a group-suspending agent capable of polysaccharides. It ties water molecules in intertwined macromolecular chains that inhibit water movement [10]. PGA is a material thickener that effectively suspends because of its ability to protect colloids. Concentration PGA approval is used as the *suspending agent* is between 5 - 10% [11]. In pharmacies, gums are frequently employed as emulsifying, suspending, and thickening agents. Natural gums are hydrophilic colloids that dissolve in water and raise the continuous phase's viscosity, allowing for the long-term suspension of a sufficient amount of solid particles to quantify the uniform dosage [12].

Xanthan gum is one the suspending agents with characteristics of type pseudoplastic capable of thick dispersion. Viscosity resulting from the dispersion of xanthan gum in water shows extraordinary stability joints in various pH levels and temperatures [13]. Based on the results, try to mark viscosity by the theory that If viscosity suspension according to SNI is 37cP-396 cP, then formulas 1, 2, 3,4,5, and 6 have a viscosity between 37cP-396, which means its viscosity Already meets SNI. Since specific gravity is one of the parameters that affect viscosity, the goal of the specific gravity test on suspension preparations is to determine the viscosity value of the preparations[14]. Too much viscosity is unexpected because it can cause problems the moment suspension is issued from the container and difficult distributed return [15]. The sedimentation volume test aims to count the ratio deposition that occurs during its storage at certain times. Sedimentation volume is calculated by comparing the height of suspension at the end (H_u) with the height of suspension at the beginning (H_o)[16]. Good or not, suspension can be seen from the resulting sedimentation volume testing reasonable suspension price < 1 or > 1 [15]. The suspension must be able to produce a homogeneous precipitate by shaking and have a low interfacial tension so that the resulting precipitate is small [17]. Since particle size can be measured directly using a micrometer scale, which has a precise size and makes it possible to see the particles directly, particle size evaluation is performed using the microscopic method [18]. On suspension with PGA has an F value < 1 by marking the resulting viscosity; the more viscosity suspension, the slower the deposition process because the more power held given a material suspension [15]. Meanwhile, the suspension with xanthan gum tended to have F values close to 1, showing that the particle resulting in the suspension dispersed equally in fluid in the carrier so that its viscosity tends to be smaller. The suspension must be easily dispersible to guarantee dosage homogeneity because it generates sediment while stored. The system is considered caked if sediment is still present even after vigorous shaking for a predetermined amount of time.

The resulting suspension's size included particles in dispersion rough Because of a size bigger than $0.5\mu\text{m}$. Small particles have a surface area of large particles, so there is interaction between particles and particle formation in compact aggregate. On suspension with PGA, there is a marked size of more particles compared to xanthan gum, more so for big particles, and so will the fast suspension deposition due to its broad cross-section. The size of the particle suspension of paracetamol increases along with increased time storage and concentration. Meanwhile, xanthan gum has size-inclined particles smaller, which causes bonds between tightly packed particles [19]. The dispersibility test aims to know how long it will take to disperse return particles that have been settled. This depends on the type of particles formed in a system suspension. If particles are in the form unit separate, they will form very sediment compact (cake), so preparation is complex to redispersed. On the other

hand, if the particle's aggregate is loose, particle No may be bound strictly between one and others, and suspension No forms a complex and dense mass so that preparation can still be dispersed [10]. On the results, a test was obtained to mark the dispersibility of the suspension with PGA as faster than xanthan gum p the, influenced by the viscosity of the suspension, increasingly tall viscosity preparation so the low resulting dispersibility. A good suspension has small particles, but not too small, because particles that are too small will float and make it difficult to distribute them evenly in the carrier [20].

Based on *the Shapiro-Wilk* test shows that all formulas are distributed normally and homogeneously with significance $(p) > 0.05$, so we can next with the *Oneway test Anova*. The three formulas obtained mark significance $(p) < 0.05$, meaning a meaningful difference exists. This matter strengthened with further tests *on HSD, which showed* statistically significant results at each testing time.

4 Conclusion

We concluded that the effect of suspending agents is different from the characteristic physical paracetamol suspension and that provides the characteristic of the most stable Physical between the sixth formula is the PGA suspension formula with PGA suspending agent concentration 5% up to storage time 28 days.

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Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors disclose no conflict.

Author contribution statement

Lina W and Nanda TZ., conceived and designed the study. Lina W and Nanda TZ performed the computational analysis. Lina W and Nanda TZ wrote the manuscript. Lina W provided the funding. Lina W and Nanda TZ, Dinda W and Alifia N A revised the manuscript. All authors have read and approved the manuscript and have made significant contributions to this study.

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