



Study Effect of Storage Temperature and Packaging Methods on Physical Characteristics of Gelatin-Based Moringa Leaf Extract Chewable Gummy

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Introduction



M. oleifera leaves extract contain the high activity of antioxidant

M. oleifera leaves extract are potential to be developed into chewable gummy tablets

Formulation of chewable gummy based *Moringa oleifera* leaf extract using 10% gelatin

Optimization of the storage temperature and packaging method



Storage temperature

Packaging method

Stability evaluation of the chewable gummy tablet based *Moringa oleifera* leaf extract

Evaluation the effect of storage condition and packaging method on physical characteristics



Cool temperature 8-15°C

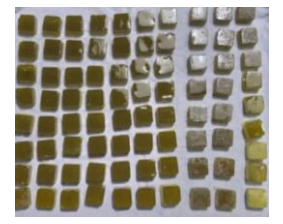
Room temperature 20-25°C

Individual and squeezable bag





Methodology



Preparation of *M. oleifera* leaves extract chewable gummy using 10% of gelatin



Divided into four groups based on the design of storage temperature and packaging method



Group 1



Group 2



Group 3



Group 4



Evaluation of the physical characteristics of the chewable gummy from each group



Descriptive analysis



- Physical observation
- Weight variation
- Dimension
- Texture analysis (chewiness, gumminess, hardness)



Statistic analysis (Factorial)



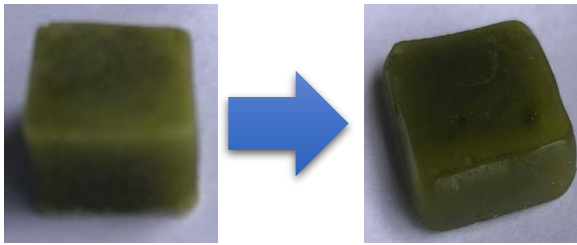
- Swelling ratio
- Dispersion time
- Syneresis percentage





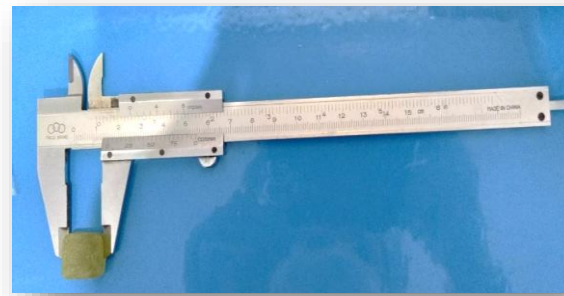
Results and Discussion

Physical observation



The alteration of tablet shape and dimension are observed in the group 1 (Room temperature and individual package)

Chewable gummy dimension



Group 1 exhibited the change in length and thickness > 5%, however the other groups fulfill the specification ($\leq 5\%$)

Weight variation



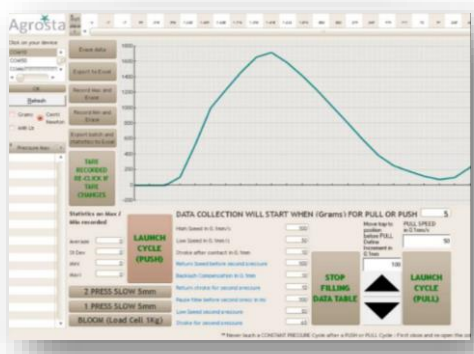
Weight variation of all the groups during storage meet the specification (NMT 7.5 %, calculate from the average weight of chewable gummy)





Results and Discussion

Texture Analysis



Observation time	Room Temperature		Cool Temperature	
	Individual package (Group 1)	Squeezable Bag (Group 2)	Individual package (Group 3)	Squeezable Bag (Group 4)
Week 0				
Chewiness (Nmm)	18.01	36.89	111.07	76.77
Gumminess (Nmm)	44.03	73.77	271.5	170.66
Hardness (N)	542	597	2.249	1.317
Week 4				
Chewiness (Nmm)	51.31	24.24	91.72	62.90
Gumminess (Nmm)	128.29	60.61	229.31	157.25
Hardness (N)	1.427	974.67	2.174.67	1.592.33

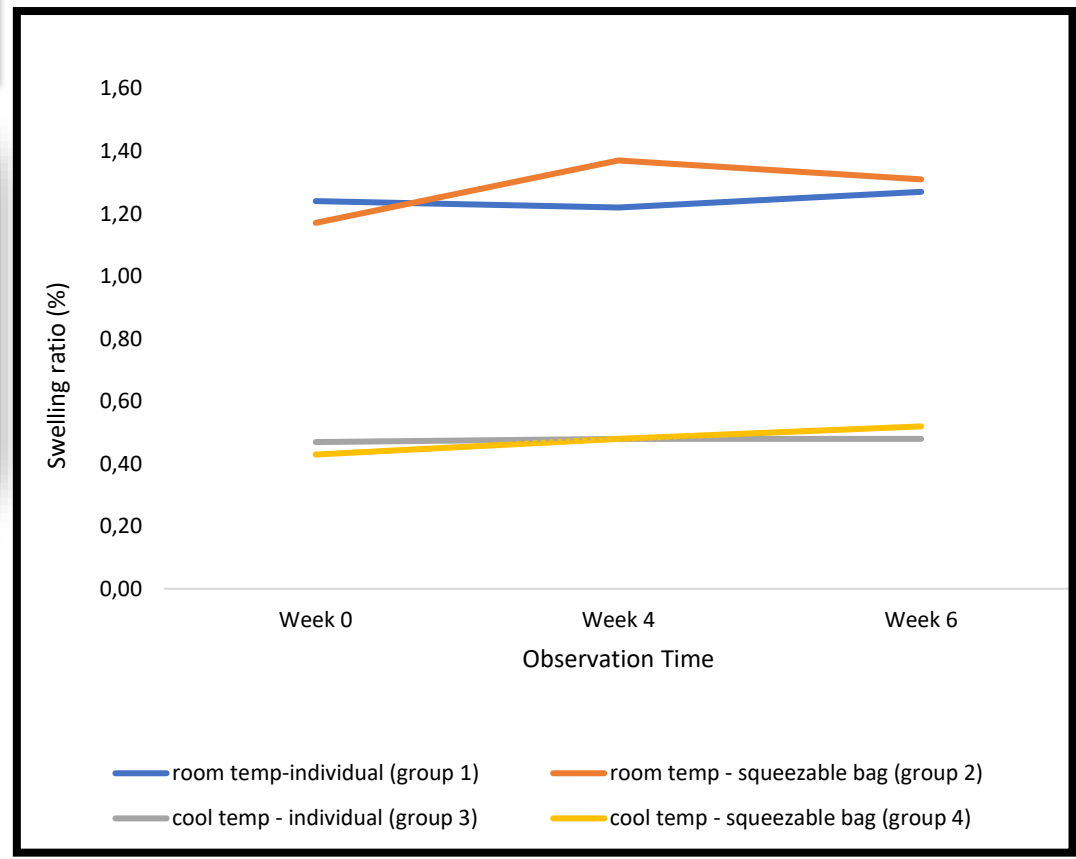
Increase in hardness, decrease in chewiness and gumminess observed for the chewable gummy stored at controlled room temperature for both packaging conditions and squeezable bag-cool temperature

The chewable gummy which are stored in cool temperature-individual package exhibit the decrease of chewiness, gumminess, and hardness



Result and Discussion

Swelling ratio

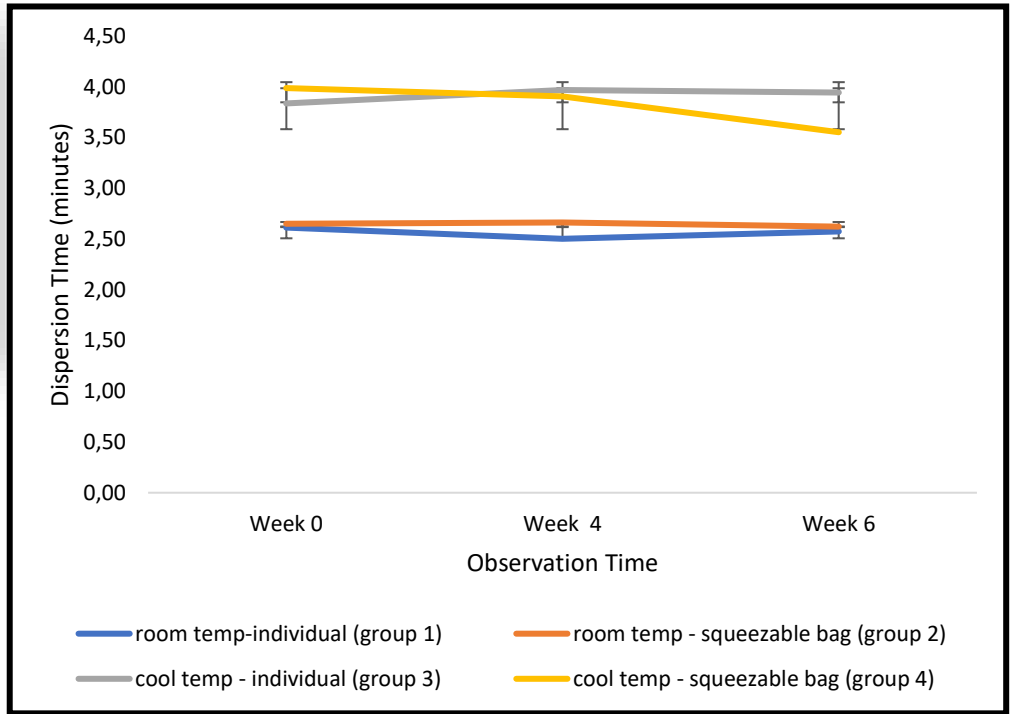


- The swelling ratio of chewable gummy tablet from group 1 and 2 (stored in room temperature for both packaging condition) were more than 1.0%
- The swelling ratio of chewable gummy which are stored in cool temperature were less than 1.0%
- The lowest swelling ratio showed by group 3 due to the stabilized hydrogen bonding between water molecules and gelatin in the cool temperature and individual package



Result and Discussion

Dispersion Time

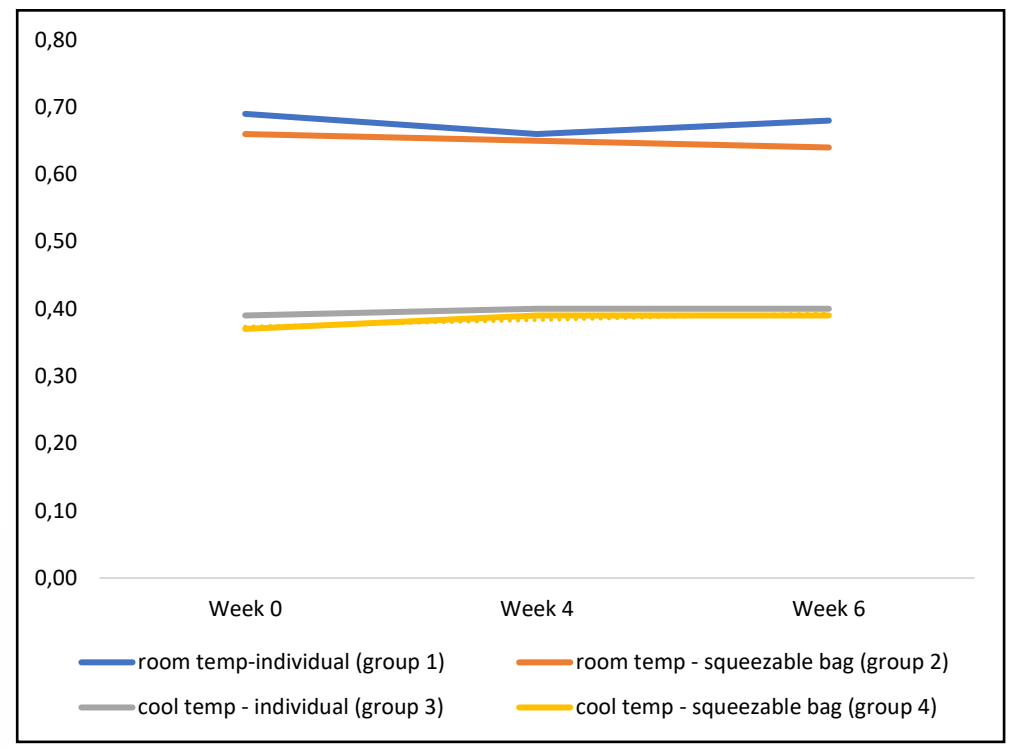


- The dispersion time of chewable gummy tablet from all groups were less than 15 minutes (fulfill the specification)
- The dispersion time of chewable gummy which are stored in cool temperature was longer than room temperature → stronger polymer network → hinder the penetration of water molecules



Result and Discussion

Syneresis



The result of syneresis evaluation showed that all the groups exhibited syneresis less than 1.0%. Syneresis percentage from the chewable gummy which is stored in room temperature higher than the cool temperature → loose three dimension network of polymer-water-sucrose in room temperature → water easily pull out form the chewable gummy





Result and Discussion

Statistical analysis

Observation Time	Dispersion time	Swelling ratio	Syneresis
Week 0			
Storage temperature	0,000*	0,000*	0,000*
Packaging method	0,170	0,068	0,148
Interaction of storage temperature and packaging method	0,239	0,667	0,308
Minggu 4			
Storage temperature	0,000*	0,000*	0,000*
Packaging method	0,303	0,666	0,348
Interaction of storage temperature and packaging method	0,064	0,770	0,719
Minggu 6			
Storage temperature	0,000*	0,000*	0,000*
Packaging method	0,777	0,227	0,164
Interaction of storage temperature and packaging method	0,938	0,890	0,676

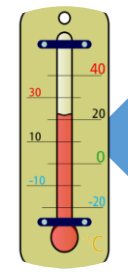
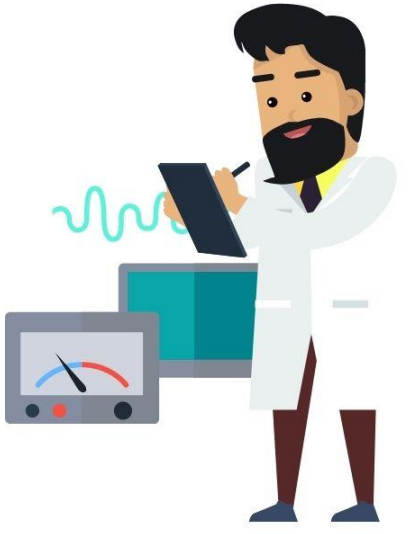


The storage temperature significantly influences the physical characteristics of chewable gummy based *Moringa oleifera* leaf extract during storage





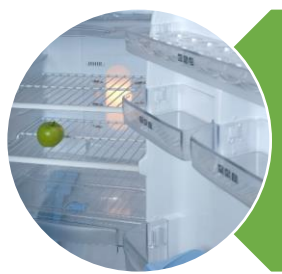
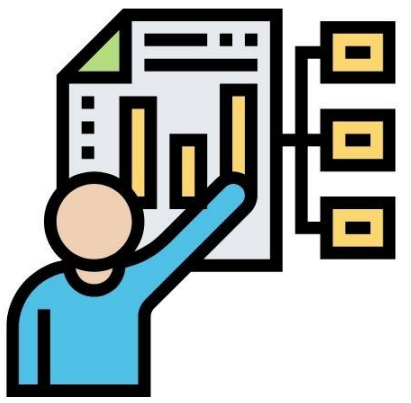
Conclusion



The storage temperature significantly influences the physical characteristics of chewable gummy based *Moringa oleifera* leaf extract during storage



The packaging method and interaction between storage temperature – packaging method did not affect the physical characteristics of prepared chewable gummy



The cool temperature (8-15°C) was recommended as the storage temperature to exhibit desired physical characteristics of chewable gummy





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References

- Alugoju, P. and Periyasamy, L. (2014) 'Free Radicals : Properties , Sources , Targets , and Their Implication in Various Diseases', *Ind J Clin Biochem*, 30(1), pp. 10–26. doi: 10.1007/s12291-014-0446-0.
- United States Pharmacopeial Convection (2018) 'USP Chewable Gels Monographs', in *The United States Pharmacopeia*.
- ižauskaitė, U. *et al.* (2019) 'Natural Ingredients-Based Gummy Bear Composition Designed According to Texture Analysis and Sensory Evaluation In Vivo', *Molecules*, 24(1442), pp. 1–16. doi: 10.3390/molecules24071442.
- Dille, M. J. *et al.* (2017) 'Soft , chewable gelatin-based pharmaceutical oral formulations : a technical approach', *Pharmaceutical Development and Technology*, 0(0), pp. 1–8. doi: 10.1080/10837450.2017.1332642.
- Gbenga, B. L. and Taiwo, Y. (2016) 'Studies of the Effect of Storage Conditions on Some Pharmaceutical Parameters of Powders and Tablets', *Dhaka Univ. J. Pharm. Sci.*, 14(2), pp. 147–151.
- Mahat, M. M. *et al.* (2020) 'The Sensory Evaluation and Mechanical Properties of Functional Gummy in the Malaysian Market', (October). doi: 10.20944/preprints202010.0213.v1.
- Matulyte, I. *et al.* (2021) 'The effect of myristica fragrans on texture properties and shelf-life of innovative chewable gel tablets', *Pharmaceutics*, 13(2), pp. 1–15. doi: 10.3390/pharmaceutics13020238.





Thank You

