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Systematic Literature Review: The Effect Of Different Binders On Paracetamol Tablets

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Abstract

This study aims to examine the effect of different binders on the physical quality of paracetamol tablets using the Systematic Literature Review (SLR) method. Paracetamol tablets are one of the preparations widely used as analgesics and antipyretics, so the choice of binder plays an important role in determining tablet quality, such as hardness, friability, disintegration time, dissolution, and physical and chemical stability. The method used is a literature study of various studies related to variations in binders in paracetamol tablet formulations and evaluation of their physical quality. The results of the study indicate that the type and concentration of binders have a significant effect on tablet characteristics. Binders such as PVP, gelatin, kawista pectin, konjac glucomannan, durian seed starch, cassava starch, pregelatinized corn starch phosphate, and various other natural starches show different effects on tablet hardness, friability, disintegration time, and dissolution. Natural binders such as pectin and modified starch show the most optimal results because they are able to produce tablets with good physical quality while maintaining optimal drug release. While synthetic binders such as PVP and gelatin provide strong binding strength and improve tablet stability, their use in high concentrations can prolong disintegration time and decrease dissolution. Overall, selecting the right binder is crucial for producing paracetamol tablets that meet pharmacopoeial requirements and provide optimal therapeutic efficacy.

Keywords: Paracetamol tablets, Binder, Physical quality of tablets, Tablet formulation.

INTRODUCTION

Tablets are the most widely used solid pharmaceutical dosage form in therapy due to their high stability, ease of distribution, and guaranteed dosage accuracy. In tablet formulations, the presence of excipients not only functions as additives but also significantly determines the final quality of the preparation. One excipient that plays a crucial role is the binder, which functions to increase interparticle cohesion, allowing the formation of a compact tablet that does not easily disintegrate during handling. The selection of the type and concentration of the binder has been shown to directly influence tablet quality parameters such as hardness, friability, and disintegration time (Aulton & Taylor, 2013).

Paracetamol is an analgesic and antipyretic drug widely used globally for the treatment of mild to moderate pain and fever. However, paracetamol has poor physical characteristics, including poor flow and compressibility, which often pose challenges in tablet manufacturing. Therefore, appropriate formulation strategies are required, one of which is the use of binders, to improve granulation and compression properties. Variations in binders, both synthetic such as polyvinylpyrrolidone (PVP) and natural ingredients such as starch, have been shown to have different effects on the quality of the resulting paracetamol tablets (Sarkar *et al*., 2022).

Differences in the physicochemical characteristics of binders, such as viscosity, solubility, and adhesion, play a crucial role in determining the mechanism of tablet formation. Binders with high viscosity generally increase the mechanical strength of tablets, but can also slow down the disintegration and dissolution of drugs. Conversely, binders with low viscosity tend to produce tablets that disintegrate more quickly but are less mechanically strong. This situation indicates that the choice of binder cannot be done haphazardly, but must consider the balance between tablet strength and active ingredient release to achieve optimal therapeutic effects (Khairnar *et al*., 2024).

With increasing attention to safety and sustainability, research on the use of natural binders in tablet formulations continues to grow. Natural ingredients such as mucilages, gums, and polysaccharides are increasingly being explored due to their biocompatibility, ease of degradation,

and relative safety compared to synthetic materials. Several studies have reported that natural binders can provide comparable performance to synthetic materials in improving tablet quality, while also supporting the concept of green pharmacy in the development of modern pharmaceutical products (Singh *et al*., 2021).

However, various studies related to the use of binders in paracetamol tablets still show varying results, primarily due to differences in formulation methods, types of ingredients, and evaluation parameters used. This makes it difficult to draw comprehensive conclusions regarding the effect of each binder on tablet characteristics. Therefore, a systematic literature review is needed that can systematically and critically integrate the findings of recent research. This can provide a clearer picture of the relationship between binder type and paracetamol tablet quality and serve as a basis for developing more optimal formulations (Pockle *et al*., 2023).

RESEARCH METHODS

This study uses the Systematic Literature Review (SLR) method with a qualitative descriptive approach to examine the effect of different binders on the physical quality of paracetamol tablets. The data used are secondary data obtained from various scientific articles, both national and international journals relevant to the research topic. The selected literature comes from publications within the last 5 years, to ensure the data used is still relevant, valid, and has scientific novelty. The focus of the study in this study includes the types of binders used in paracetamol tablet formulations, such as starch, PVP (Polyvinylpyrrolidone), gelatin, and other binders, as well as their effects on the physical properties of the tablets.

Data collection was conducted through searches of several scientific databases such as Google Scholar, PubMed, ScienceDirect, and Garuda using keywords such as "paracetamol tablets", "binding agent", "binder", "tablet formulation", "tablet physical quality testing", and "tablet evaluation". Inclusion criteria for this study included articles discussing paracetamol tablet formulations with various binders, articles containing data on tablet physical quality evaluations such as hardness, friability, disintegration time, weight uniformity, and dissolution. Articles that were irrelevant to the topic, did not have complete data, or did not specifically discuss binders were excluded from the study.

The data obtained were then selected, compared, and analyzed comparatively from each study found. The results of the analysis are presented in tabular form to facilitate comparison between studies. The analysis focused on the relationship between the type and concentration of binder and the physical quality of paracetamol tablets, thus identifying the most effective binder in producing tablets that meet pharmacopoeial requirements. This approach is expected to provide a systematic and comprehensive overview of the role of binders in paracetamol tablet formulation.

RESULTS AND DISCUSSION

Author & Year	Article Title	Method	Binder	Binder Concentration	Conclusion
Sipatu & Ani, 2023	Formulasi Tablet Paracetamol menggunakan Pati Biji Durian (*Durio zibethinus* Murr) sebagai	Direct compression	Durian seed starch	8%, 10%, and 12%	Formula I (8%) showed the best results because it was able to meet the Pharmacopoeia requirements with a dissolution value of 88.32%, so that the

	Bahan Pengikat secara Kempa Langsung				8% concentration provided the most optimal drug release effectiveness.
Cahyani *et al*., 2023	Formulasi tablet parasetamol dengan kombinasi PVP dan amilum umbi porang (*Amorphopallus onchopyllus*) sebagai bahan pengikat terhadap sifat fisik tablet	Wet granulation	Combination of PVP and porang tuber starch	PVP: 0%, 1%, 3%, and 5% Porang: 5%, 0%, 6%, and 7%	Formula I (0% PVP and 5% porang starch) gave the best results with a hardness value of 7.30 kg and the fastest disintegration time of 9.6 minutes, thus producing tablets with a good balance between physical strength and disintegration ability.
Sinaga *et al*., 2025	Preformulasi: Konsentrasi Amilum Buah Pisang Singali-Ngali (*Musa Acuminata* Lady Finger) Sebagai Bahan Pengikat Terhadap Tablet Paracetamol Metode Granulasi Basah yang Memenuhi Persyaratan Farmakope	Wet granulation	Singali-ngali banana starch	5%, 7%, and 9%	Formula II (7%) provided the best performance with a flow time of 4.10 seconds, an angle of repose of 24°, and a disintegration time of 11.32 minutes, thus showing the most optimal granule and tablet characteristics and meeting the Pharmacopoeia requirements.
Fegade *et al*., 2023	Formulation and Evaluation of Paracetamol Tablet to Assess Binding Property of *Limonia Acidissima* Pectin	Wet granulation	Kawista Pectin (*Limonia acidissima*)	2%, 4%, 6%, and 8%	Formula F3 (6%) achieved the highest dissolution of 99.64% with the best physical properties of the tablet, proving that pectin is effective as a natural binder with the highest drug release.
Kosasih *et al*., 2025	Development of Paracetamol	Wet granulation	Phosphate Pregelatiniz	3%, 4%, 5%, 6%, and 7%	Formula F5 (7%) excels with the

	Tablet Formulations Using Phosphate-Pregelatinized Cornstarch as Binders		ed Corn Starch		highest dissolution of 99.28%, the best drug content and stability, thus providing an optimal combination of tablet strength and maximum drug release.
Kulkarni *et al*., 2022	Formulation and Evaluation of Paracetamol Tablets using Coconut Oil as a Binder	Dry granulation	Coconut oil	1%, 2%, and 3%	Formula 1 showed the best results with the fastest disintegration time (2 minutes 12 seconds), optimal dissolution, and the best flow and compressibility properties.
Lestari & Eliana, 2024	Reworking potential of Cassava starch as a binder in the production of paracetamol tablets using wet granulation method	Wet granulation	Cassava starch	1.8% and 2.0%	The best formula is Formula 2 with a concentration of 2.0%, because it is able to produce greater and optimal hardness and compactibility values.
Lestari & Okana, 2025	Reworking Potential of Polyvinylpyrlidone K-25 as a Binder in the Production of Paracetamol Tablets	Wet Granulation	PVP K-25	2% and 4%	PVP K-25 can maintain its potency after reworking (re-compressing). Formula 2 with a 4% concentration is the best formula due to its better flow properties and more optimal intergranule bonding compared to the 2% concentration.
Wijayanto & Herdianty, 2021	Formulation of Granules and Tablets Active Ingredient Paracetamol Ibuprofen and Its Evaluation Results	Dry granulation	Combination of 2% PVP and Variation of Manihot Starch	3%, 10% and 20%	Formula 1 (3%) successfully underwent the slugging process and produced granules. Formulas 2 and 3 could not be processed because they did not form

					granules. Therefore, the concentration in F1 is the best.
Krushnakant, 2024	Formulation and evaluation of paracetamol tablets using natural binders	Wet Granulation	Aliv Seeds (*Lepidium sativum*) and Basil Seeds (*Ocimum basilicum*)	3.25% (25 mg)	Basil seeds are better because they can bind more strongly, disintegrate faster, and dissolve better.
Zilhadia *et al*., 2021	Preparation and Evaluation on Paracetamol Tablets Using Goatskin Gelatin as a New Binder	Wet Granulation	Goat skin gelatin	2%, 3%, and 4%	The best formulation is the use of goat skin gelatin with a concentration of 3% due to acceptable brittleness, good hardness, faster disintegration time and easier solubility compared to bovine gelatin.
Kumereshwaran& Rahman, 2024	Formulation and Evaluation of Paracetamol Tablets Using Konjac Glucomannan as Natural Halal Binder.	Wet Granulation	Konjac glucomannan	5%, 10%, 15%, and 20%	The use of konjac glucomannan at 20% showed the most optimal results with the lowest friability and optimal tablet binding.

Discussion

In various studies related to paracetamol tablet formulations and the binders used, they have very varied physicochemical characteristics, such as synthetic polymer materials or natural polysaccharides. In the study of Cahyani *et al*. (2023) using a combination of PVP and Porang Tuber Starch binder materials, PVP is known as a synthetic polymer that is very stable, easily soluble in water and various organic solvents such as alcohol, odorless, and has good flow and compressibility properties. The use of PVP can produce tablets that are not hard, have a fast disintegration time so that the tablets are quickly dissolved, absorbed and provide a therapeutic effect (Putra, 2019). Porang tuber starch contains glucomannan compounds which are non-starch polysaccharides and water-soluble fiber. Glucomannan provides high viscosity characteristics, good swelling ability when in contact with water, and strong adhesive power to bind paracetamol powder particles (Handayani *et al*., 2020).

In Sinaga's *et al*(2025) used Singali-Ngali Banana Fruit Starch (*Musa acuminata* Lady Finger) as a binding agent, Singali-Ngali Banana Fruit Starch is a very abundant natural carbohydrate source. Based on its nutritional characteristics, banana starch contains about 93% carbohydrates with a low water content (about 2.93%). From a physicochemical perspective, this material is in the form of a fine white powder, odorless, and has the ability to absorb water and form a cohesive mass during the wetting process, so it is very suitable for use as a binding agent in the wet granulation method

(Shekharah *et al*., 2023). In the study of Sipatu & Ani (2023) using Durian Seed Starch (*Durio zibethinus* Murr) as a binding agent, durian seed starch consists of a mixture of amylose and amylopectin which functions as a natural binding agent. The characteristics of this starch include its ability to form strong inter-particle bonds, durian seed starch is in the form of a fine powder that is white, tasteless, and odorless, so it does not interfere with the taste or odor of the active substance paracetamol (Nurwidiyati *et al*., 2022).

In Fegade's *et al*(2023) used Kawista Pectin (*Limonia acidissima*) as a binding agent, pectin is a natural polysaccharide extracted from the *Limonia acidissima* plant. The characteristics of this pectin are its excellent ability to form gels and provide strong inter-particle bonds. This is very important for uniting paracetamol powder which is hydrophobic and has relatively low compressibility (Voragen *et al*., 2009). In the study of Kokasih *et al* (2025) using Phosphate Pregelatinized Corn Starch as a binding agent, corn starch often has limitations in terms of flow properties and binding ability, so it is chemically modified using the addition of disodium hidrogen phosphate and the pregelatinization process. The characteristics of this modification are the formation of starch that is more soluble in cold water, has a more stable viscosity, and has much better flow properties than the original starch (Compart *et al*., 2023). In research by Kulkarni *et al*. (2022), coconut oil contains up to 85% saturated triglycerides, which are used as a binding agent or additional lubricant. Its liquid or semi-solid nature serves to increase lubrication efficiency in the die cavity while also aiding particle agglomeration (Lachman *et al*., 1976).

In a study by Lestari & Eliana (2024), cassava starch was used as a binding agent. Cassava starch is composed of amylose and amylopeptin. The amylopeptin content in cassava starch is relatively high, at around 83%. The high amylopeptin content allows cassava starch to produce a colloidal solution that forms a sticky mass (Estrada *et al*.,2021). In the study of Lestari & Okana (2025), PVP K-25 was used, which has excellent cohesiveness characteristics, is able to form strong inter-particle bonds, and has high physical and chemical stability (Khairnar *et al*., 2024). In the study of Wijayanto & Herdianty (2021), 2% PVP was used and variations of manihot starch as the binder. PVP (Polyvinylpyrrolidone) was the binder used in this study. PVP is known to be highly soluble in water and has strong binding power, which is very useful in the formulation of moisture-sensitive granules. This study varied the concentration of the additional binder, namely manihot starch.

In the study of Krushnakant (2024), a natural binder was used from certain plant extracts that have mucilage-forming characteristics or sap that can glue powder during wet granulation. In the study of Kumereshwaran & Rahman (2024), Konjac Glucomannan from Amorphophallus konjac tubers was used, which has halal properties and functions as a hydrocolloid excipient. Its main characteristic is the ability to absorb water and form a very strong gel that can maintain tablet integrity. In the study of Zilhadia *et al*. (2021), gelatin extracted from goat skin was used as an alternative halal binder. The characteristics of this gelatin include its ability to form a flexible and cohesive matrix network during the wet granulation process, as well as having good solubility at body temperature.

The choice of binder in paracetamol tablet formulation significantly influences the manufacturing method used, as each ingredient has different abilities in binding particles, improving granule flow, and increasing tablet cohesiveness. In wet granulation, binders are often chosen because they can form strong interparticle bonds after wetting, resulting in more uniform granules and stronger tablets. This is consistent with Cahyani's *et al*(2023), where the use of 5% porang tuber starch produced tablets with a hardness of 7.30 kg and a disintegration time of 9.6 minutes, indicating a good balance between tablet strength and its ability to disintegrate. Similar results were also found by Sinaga *et al* (2025) who reported that 7% singali-ngali banana starch provided excellent granule flow properties and a disintegration time that still met the standards. In addition, natural binders such as kawista pectin and konjac glucomannan have also been shown to improve the physical quality of tablets, especially in terms of binding power, dissolution, and low friability (Handayani *et al*., 2020). This shows that wet granulation is still an effective method for producing tablets with optimal physical quality.

In dry granulation, the granule formation process is carried out without the addition of liquid, making it simpler and more suitable for materials sensitive to water or heat. This method relies heavily on the binder's ability to form a sufficiently dense mass before being crushed back into granules. Research by Wijayanto & Herdianty (2021) showed that a combination of 2% PVP and 3% starch manihot was the most ideal composition because only this formula successfully formed granules through the slugging process. In dry granulation, the precise selection of the type and concentration of the binder is key to properly forming granules ready for tableting.

Unlike the two methods mentioned above, direct compression is a simpler process because tablets can be molded directly without a granulation step. This method can only be used on materials that have good flow and compressibility. This was proven in a study by Sipatu & Ani (2023), where durian seed starch at a concentration of 8% produced the most optimal results with a dissolution value of 88.32% and met Pharmacopoeia requirements. These results indicate that durian seed starch not only acts as a good binder but also supports optimal release of active ingredients. Each method has its own advantages, but its success is still largely determined by the suitability of the binder used in the tablet formulation.

In tablet manufacturing, the choice of binder significantly influences the friability, hardness, disintegration, and dissolution of the tablet preparation (Kumereshwaran & Rahman, 2024; Krushnakant, 2024). The type of binder and its concentration are important factors that directly affect tablet hardness and friability, which are the main quality parameters in tablet formulation (Sipatu & Ani, 2023). When using goat skin gelatin, higher gelatin concentrations increase hardness and decrease friability (Zilhadia *et al*., 2021). In a study conducted by Krushnakant (2024), Aliv seeds produced better hardness and lower friability than basil seeds. Meanwhile, in a study by Kumereshwaran & Rahman (2024), the use of Konjac glucomannan with a higher concentration increased tablet binding capacity. Konjac glucomannan levels of 20% showed an acceptable level of friability.

The use of Kawista Pectin as a binder increases the bond strength between particles in tablets. Kawista Pectin as a binder has cohesive and adhesive properties and is polymeric because the binder is added to the granule mixture to increase agglomerate formation, granule flow rate, and compression. The binder provides plasticity that can increase the bond strength between particles in the tablet and the drug release properties that vary according to the formulation (Fegade *et al*., 2023). The type, amount, and method of tablet manufacturing affect the quality and compression of the tablets, and changes in coconut oil concentration affect tablet performance. The use of coconut oil with a concentration of 1% shows optimal binding results with better compression compared to other concentrations (Kulkarni *et al*., 2022).

PVP K-25 as a binder in the manufacture of paracetamol tablets shows hardness and brittleness as tablet properties that are affected by the binder. Increasing the binder concentration increases hardness and changes in binder effectiveness can cause increased brittleness (Lestari & Okana, 2025). The Singali-Ngali banana starch binder has a positive effect and all formulas meet the binder requirements. The addition of the concentration of Singali-Ngali banana starch as a binder significantly affects the physical properties of paracetamol tablets (Sinaga *et al*., 2025). Reprocessing of cassava starch as a binder in the production of paracetamol tablets using the wet granulation method can affect hardness, brittleness, and disintegration time, the results show that a higher binder concentration affects hardness and brittleness related to hardness (Lestari & Eliana, 2024). The use of a combination of PVP and manihot starch binders shows an effect on hardness and low tablet hardness can increase the level of brittleness (Wijayanto & Herdianty, 2021).

The use of pregelatinized Corn Flour with Phosphate as a binder with a concentration (3–7%) directly affects tablet hardness (5.05–5.80 kg) and friability (0.50–1.61%). Higher binder concentrations increase tablet hardness and decrease friability (Kosasih *et al*., 2025). The use of Durian Seed Starch as a binder with the direct compression method shows that at concentrations of 8%, 10%, and 12% there are differences in tablet physical properties, including hardness and friability. A concentration of 8% has optimal ability as a binder (Sipatu & Ani, 2023). The combination of PVP

and porang tuber starch as a binder affects tablet hardness. Among all the formulas tested, only formula I (0% PVP: 5% Porang Tuber Starch) meets the hardness requirements (7.30 kg), and the fastest disintegration time is 9.6 minutes. The higher the concentration of PVP and porang tuber starch as a binder, the tablet hardness tends to increase and the disintegration time becomes longer, while the tablet fragility tends to decrease (Cahyani *et al*., 2023).

The binder affects tablet hardness, disintegration time, and dissolution rate, which influences whether the tablet behaves more like a rapid-release system or a controlled-release system (Kulkarni *et al*., 2022). The binder affects disintegration time, and disintegration time is an indicator of how quickly the tablet releases its active ingredient (Lestari & Okana, 2025). In a study by Zilhadia *et al*. (2021) on goatskin gelatin as a binder, increasing the concentration of the binder resulted in a harder tablet, reduced friability, and slowed the disintegration process. However, the tablet still dissolved well and was more soluble than tablets using bovine gelatin. A study by Krushnakant (2024) stated that Aliv seeds and basil seeds as binders could disintegrate in less than 15 minutes. Basil seeds disintegrated faster and showed a better dissolution rate than Aliv seeds.

Higher levels of Konjac glucomannan improve tablet binding and integrity. However, binder levels can affect dissolution rates and potentially lead to slower controlled release or rapid dissolution, depending on the formulation. Lower levels of Konjac glucomannan result in rapid disintegration (Kumereshwaran & Rahman, 2024). A study by Fegade *et al*. (2023) stated that the primary way to determine whether a kawista pectin binder is of good quality is through in vitro release pattern analysis, and that changes in pectin concentration result in differences in release kinetics. Formulation 3 with a binder concentration of 6% showed optimal results following the Higuchi model and achieved a cumulative drug release of 99.64%.

In a study by Kulkarni *et al*. (2022) changes in binder concentration caused varying disintegration times, ranging from 2 minutes 12 seconds to 3 minutes 10 seconds, and dissolution tests showed drug release of 61.4% to 76.25% after 60 minutes. When using coconut oil as a binding agent, the use of a 1% concentration of coconut oil provided the most optimal compression results. Increasing the concentration of PVP K-25 increased hardness and also prolonged the disintegration time, so that formulas with higher binder concentrations behaved more like slow-release tablets (Lestari & Okana, 2025). The use of Singali-ngali banana starch showed an effect on disintegration and dissolution times where the use of 5%, 7%, and 9% concentrations showed compliance with existing standards and a 7% concentration showed the most optimal tablet evaluation results (Sinaga *et al*., 2025).

Higher concentrations of cassava starch further increase hardness and prolong disintegration time, so formulas with higher binder concentrations also have slower release (Lestari & Eliana, 2024). Binder concentration affects tablet disintegration time, which can affect how quickly the drug is released. Higher binder concentrations generally increase hardness and prolong disintegration time, indicating slower release, while lower binder concentrations result in faster disintegration and faster release. Disintegrants are used to break down tablets to release the active ingredient. Formula 1 with a 3% concentration has a disintegration time of 4 minutes (Wijayanto & Herdianty, 2021).

In a study by Sipatu & Ani (2023) durian seed starch as a binder with a concentration of 8% met the dissolution requirements, while concentrations of 10% and 12% did not, so higher binder concentrations were associated with poorer dissolution performance. Increasing binder concentrations tend to make tablets harder and slow down disintegration which can slow drug release and reduce dissolution, while lower binder concentrations tend to result in faster disintegration and faster release. This is supported by a study by Cahyani *et al*. (2023) where increasing the concentration of a combination of PVP and porang tuber starch causes tablet hardness to increase and disintegration time to become longer, as well as a study by Kosasih *et al*. (2025) where inadequate binding power at 3% and 4% corn starch usage causes the active substance to be released and dissolved immediately.

The choice of binder in various studies has demonstrated its important role in maintaining the physical and chemical stability of tablets, particularly in terms of organoleptic parameters, size uniformity, and weight uniformity. Organoleptically, the use of binders such as PVP, modified starch, pectin, gelatin, and natural binders such as konjac glucomannan and aliv produces tablets with a solid

shape, uniform color, smooth surface, and odorless, thus indicating no physical changes during the formulation process and maintained stability (Cahyani *et al*., 2023). This indicates that the adhesive and cohesive properties of the binder are able to maintain the integrity of the tablet structure during the printing process and storage (Zilhadia *et al*., 2021).

Uniformity of tablet size in various studies also demonstrates results that meet Pharmacopoeia standards, with tablet diameter and thickness within a consistent range. This is because the binder increases granule cohesiveness and compressibility, allowing for more consistent die filling and molding processes. Therefore, despite variations in binder concentration, tablet dimensions remain stable, remaining unchanged. This indicates that the binder plays a crucial role in maintaining uniform tablet shape and size throughout the production process (Sipatu & Ani, 2023).

Regarding weight uniformity, all studies showed that the tablets met the requirements because there were no deviations exceeding the specified limits. This indicates that the binder is capable of producing a homogeneous granule mixture and improving the powder's flow properties, thus filling the impression cavity evenly in each tablet. With a uniform distribution of active ingredients and excipients, the dosage contained in each tablet becomes more accurate and consistent. Therefore, the role of the binder is very important in maintaining the physical stability of the tablet, especially in terms of weight uniformity (Sipatu & Ani, 2023).

In terms of chemical stability, the type and concentration of binder significantly influence drug release. Binders such as pectin and modified starch can enhance drug solubility and dissolution due to their water-absorbing properties and facilitate fluid penetration into the tablet matrix. Conversely, using binders at too high a concentration can cause interparticle bonds to become too strong, inhibiting the disintegration process and reducing drug release. This indicates that the binder concentration must be selected appropriately to avoid compromising drug bioavailability. Therefore, the balance between bond strength and drug release capacity is a key factor in determining the chemical stability of a preparation (Fegade *et al*., 2023).

The effectiveness of a binder can be compared based on its ability to produce tablets with good physical properties and optimal drug release. Binders such as pectin and modified starch show the most optimal results because they are able to produce tablets with physical characteristics that meet standards while providing very high dissolution values. This indicates that both types of binders have a good balance between bond strength and drug release ability. Meanwhile, binders such as PVP and gelatin are also able to provide excellent physical stability, especially in increasing tablet cohesiveness and strength, but their use must be controlled to avoid slowing the disintegration process. On the other hand, some natural starch-based binders show a tendency to reduce drug release at high concentrations because they form bonds that are too strong (Kosasih *et al*., 2025).

Overall, the most effective binders are those that provide a balance between physical and chemical stability, that is, binders that are strong enough to form tablets but do not inhibit drug release. In this regard, pectin and modified starch can be considered the best choices because they can maintain the physical quality of the tablet while supporting optimal drug release. Synthetic binders still have advantages in increasing tablet strength, but certain natural binders show better potential in maintaining drug availability. Therefore, the choice of binder must consider not only bond strength but also the ability to support disintegration and dissolution to maintain optimal dosage effectiveness (Fegade *et al*., 2023).

CONCLUSION

Based on the results of the literature review that has been conducted, it can be concluded that differences in the type and concentration of binders have a significant influence on the physical quality of paracetamol tablets. Binders play an important role in determining tablet quality, especially in the parameters of hardness, friability, disintegration time, dissolution, and physical and chemical stability of the preparation. The use of binders with appropriate concentrations can produce tablets with quality that meets pharmacopoeial requirements, while use in too high concentrations can cause tablets to be too hard, prolong disintegration time, and reduce the rate of drug dissolution.

Natural binders such as kawista pectin, konjac glucomannan, durian seed starch, cassava starch, pregelatinized corn starch phosphate, and various other natural starches show good potential as alternative binders because they are able to produce tablets with optimal physical properties while still supporting the effective release of active ingredients. Meanwhile, synthetic binders such as PVP and gelatin have strong binding power and are able to increase the physical stability of tablets, but their use needs to be controlled so as not to inhibit the disintegration and dissolution processes.

Overall, the most effective binder is one that provides a balance between tablet strength and optimal drug release. Pectin and modified starch have shown the best results, producing tablets with physical quality that meets standards while maintaining therapeutic efficacy. Therefore, selecting the correct type and concentration of binder is crucial in paracetamol tablet formulation to produce a stable, effective preparation that meets pharmaceutical quality standards.

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