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Green Product Innovation Increase Competitive Advantage, Mediated by Green Dynamic Capability

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Abstract. *This study examines how Padang City's bakery MSMEs' competitive advantage is impacted by green product innovation and green dynamic capabilities. This research employs a quantitative methodology. 210 MSME actors were given questionnaires to complete in order to collect data. The surveys were subsequently processed using SmartPLS 4.0 software, yielding the following findings: 1) Competitive Advantage is positively and significantly impacted by Green Product Innovation; 2) Green Product Innovation is positively and significantly impacted by Green Dynamic Capability; 3) Green Dynamic Capability is positively and significantly impacted by Competitive Advantage; and 4) Green Dynamic Capability positively and significantly mediates the effect of Green Product Innovation on Competitive Advantage.*

Keywords: *Green Product Innovation, Competitive Advantage, Green Dynamic Capability*

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INTRODUCTION

Growing consumer demand for eco-friendly products and growing public awareness of environmental issues have prompted businesses to incorporate and produce eco-friendly products as a key component of gaining a competitive edge. There are several approaches to get competitive advantages from environmentally friendly technologies, despite the fact that they come with greater costs (Lestari et al., 2021; Meirun et al., 2020). This includes the company's capacity to establish prices for eco-friendly goods, increase market share by appealing to more customers, offer superior goods and services, obtain cost and location advantages, and have a strong brand to improve the company's reputation as a conscientious organization (Potjanajaruwit, 2018).

A company's ability to maintain its competitiveness in a market that is becoming more and more competitive depends on its ability to meet the demands of customers who are becoming more concerned about environmental issues and to generate sustainable added value (Millenia & Etty Murwaningsari, 2023). The ability of a business to outperform rivals in terms of the goods, services, or procedures it offers is known as competitive advantage. A corporation needs to gain a competitive advantage if it hopes to endure in the fierce competition among all business actors (Nainggolan, 2018). Indicators of competitive advantage are metrics or standards used to evaluate how much an organization has an edge over its rivals.

Product and service quality, R&D capabilities, management competencies, profits, brand image, and irreplaceable competitive advantages are some of the primary indicators of competitive advantage. These are signs that a company can not only survive but also thrive in a difficult business environment (Chang, 2011; Porter & Linde, 1995; Qiu et al., 2020). Each of these elements demonstrates how strategy, innovation, and value provided to the market are combined

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to create competitive advantage. Therefore, it may be said that a company's ability to generate greater value than its rivals is its competitive edge. This accomplishment is typically fueled by the application of numerous sustainable and successful business tactics and procedures.

One MSME food sector that is expanding quickly and exhibiting growth in Padang City is the bakery industry. The public really likes bread, which is one of the bakery industry's best goods. This is demonstrated by the fact that the average weekly consumption of bread in West Sumatra increased to 1,605 packs in 2023, a 5.12% rise over the 1,527 packs consumed in 2022. However, it is necessary to anticipate the environmental challenges that lie behind this development. The process of making a bakery uses a lot of energy, generates a lot of organic and inorganic waste, and adds to the rise in industrial pollution. MSMEs are under pressure from this circumstance to begin thinking about more environmentally friendly business methods.

Implementing green product innovation is one pertinent tactic that can both lessen adverse environmental effects and provide a fresh source of competitive advantage in the face of growing customer awareness of eco-friendly products (Qiu et al., 2020). It is known that bakery MSMEs are attempting to reduce food waste by recycling unsold products into animal feed, a straightforward innovation that has a positive impact because it not only reduces waste but also adds economic value, based on preliminary observations made by researchers on a number of bakery MSMEs. In order to lower their carbon footprints, these MSME players also frequently use environmentally beneficial and health-safe materials, as well as local raw materials.

Nevertheless, the findings of observations also demonstrate that there is still a comparatively small amount of green technology being used in the production process and product development. Wastewater, unused raw materials, and single-use plastic packaging are just a few examples of the organic and inorganic waste that is still produced by many of the food manufacturing operations in the bakery MSME sector and has not been properly managed. Improper handling of this trash poses a major risk of environmental contamination, particularly of water resources. In addition to harming the nearby ecosystem, the effects may eventually jeopardize public health.

Stakeholder theory highlights the significance of cooperation amongst many stakeholders, including as technology providers, the government, the community, and bakery MSME owners, in order to overcome this obstacle (Yu et al., 2022). According to this notion, companies have obligations not only to shareholders but also to a range of stakeholders, such as workers, clients, suppliers, communities, and the environment. This strategy recognizes that a company's long-term performance is linked to the welfare of its stakeholders and encourages businesses to adopt ethical practices and sustainable decision-making. Access to eco-friendly technology and sustainable innovation insights, such renewable energy and effective waste management, are essential for bakery MSME entrepreneurs.

Stakeholder cooperation is crucial in the green sector to improve sustainability management and tackle social and environmental issues. This partnership facilitates the development of more focused and long-lasting impactful initiatives by fostering open communication and common objectives (Valentinov, 2023). A key tactic for businesses trying to improve their competitive position is green product innovation, which is the process of developing eco-friendly products and lowering carbon footprints throughout their life cycle (Nuryakin & Maryati, 2020). The practice of incorporating environmental preservation into the creation of new products is known as "green product innovation" (Qiu et al., 2020).

Because social and environmental factors are included into every step of the invention process, this method not only produces environmentally responsible products but is also more thorough than traditional product innovation. According to research, businesses who embrace green innovation have advantages including enhanced brand recognition and increased client loyalty in addition to helping to preserve the environment (Dangelico & Pujari, 2010). Furthermore, a shift in corporate culture is frequently necessary for the successful adoption of

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green product innovation. This includes leaders' dedication and employees' active involvement in fostering a climate that encourages green (Borah et al., 2025). Green product innovation, according to a number of definitions, is the creation of new products that are seen as both inventive and ecologically friendly, as well as enhancements to production methods that lessen adverse environmental effects.

Green product innovation, according to study (Chang, 2019), involves using raw materials that are friendly to the environment, using energy efficiently throughout production, and reducing emissions and waste. Green product innovation contributes significantly to a company's competitive advantage, according to research by Abdelfattah et al., (2025). Businesses set themselves apart in the market by tackling environmental challenges, which makes it harder for rivals to copy their goods and tactics. Innovation in green products boosts brand reputation and consumer loyalty, which improves the business's ability to compete. Businesses that exhibit a dedication to sustainability have a greater chance of drawing in and keeping environmentally conscious clients as consumer knowledge of environmental issues grows.

Therefore, it is crucial for businesses that wish to stay competitive in a market that is becoming more environmentally sensitive to address the factors that drive and hinder the development of green products. Dynamic capability the ability of the business to recognize, integrate, and use its resources and competencies to develop and implement innovative environmentally friendly solutions to respond to changing and evolving situations in the context of green product innovation is necessary when adopting green product innovation (Dangelico et al., 2017). According to dynamic capability theory, one of the main factors influencing an organization's ability to maintain a competitive edge over time is its capacity to adjust and react to changes in the environment (Meirun et al., 2020; Xiao et al., 2023).

Green dynamic capability in businesses is significantly impacted by green product innovation, according to research (Qiu et al., 2020). Businesses that possess green dynamic potential typically exhibit a greater degree of involvement in working with different stakeholders, including communities, suppliers, customers, and the government. This skill makes them more receptive to fresh perspectives and adaptable to shifting consumer demands, which promotes sustainability. In addition to boosting access to resources and expertise, strong collaboration boosts the company's competitiveness in a business environment where sustainability is becoming more and more important.

Green dynamic capabilities enable companies to satisfy the increasing demand for green products, adapt to changing environmental legislation, and integrate sustainability into their core strategies. To further green innovation initiatives, these capacities promote ongoing education, the development of green knowledge, and fruitful cooperation with outside partners. Businesses with high green dynamic capacities are better equipped to develop green innovations that provide them a competitive edge and actively support long-term sustainable growth, such as energy-efficient technologies or biodegradable packaging (Borah et al., 2025). According to Qiu et al., (2020), green dynamic capabilities are a company's strategic capabilities that allow for resource management and reconstruction to support green product creation, preserve competitive advantage, and promote sustainable growth.

Thus, the implementation of green dynamic capability in practice will greatly benefit bakery MSMEs' business operations by modifying their production processes to be more ecologically friendly, such as by implementing energy-saving technology, utilizing locally sourced, sustainable raw materials, and improving waste management. Businesses must reorganize to address sustainability issues and make the required changes to stay competitive and relevant in the quickly changing business environment of today. This calls for a thorough overhaul of the business model, operations, and culture of the organization rather than just surface-level adjustments.

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In addition to enhancing their reputation and compliance readiness, companies who take the initiative to implement these changes will create new avenues for innovation, cost reduction, and long-term growth (Serrano-García et al., 2022). Green dynamic capabilities allow businesses to proactively capitalize on the growing demand for eco-friendly goods and services in addition to adhering to environmental rules. As a result, sustainability no longer acts as a barrier but rather as a catalyst for innovation and a potent market differentiator (Wu et al., 2013). The findings of a study by Qiu et al., (2020) demonstrated the significance of green dynamic skills in their impact on green product creation, which is the primary motivator for businesses to adopt eco-friendly procedures. The primary driver behind firms' adoption of sustainable practices is this competence.

One significant source of a business's competitive advantage is seen to be its green dynamic capability. Businesses may implement green innovation more successfully if they have this competence, which enhances their financial and market performance (Xiao et al., 2023). According to Yu et al., (2022), this capability also encompasses the process of gathering, evaluating, and forecasting pertinent external data, such as the advancement of eco-friendly technologies, patterns in consumer demand for eco-friendly goods, and regulations that promote long-term business expansion. (Dangelico et al., 2017; Wang & Ahmed, 2007; Zhang et al., 2020) state that reconfiguration, resource snatching, and environmental sensing are all examples of green dynamic capabilities.

Together, these three elements increase the business's ability to compete in the face of environmental issues and provide long-term value. According to the findings of the study by Does et al., (2023), a company's competitive advantage is significantly impacted by its green dynamic capability. They set themselves apart from rivals and are able to draw in eco-aware customers by incorporating environmental concerns into their business plans and operations. This skill enables businesses to innovate in processes and goods, producing extra value that appeals to customers who are becoming more environmentally conscious.

In order to address the issues that Padang City's bakery MSMEs face, green product innovation and the development of green dynamic capacities are needed. In the face of growing consumer awareness of sustainability, these two factors are crucial for assisting bakery MSMEs in gaining a competitive edge. Green dynamic capabilities give businesses the flexibility to strategically adjust to changes in the internal and external environment, while green product innovation enables business actors to produce added value that is pertinent to current market trends.

METHODS

To determine whether there is a causal relationship between variables, this study uses a quantitative research approach. The sample was obtained using the Slovin Formula of 210 managers, supervisors, and those in charge of UMKM bread in Padang City who were taken using a simple random sampling approach, this technique is used because the population data is obtained completely. According to research by (Abdelfattah et al., 2025), (Qiu et al., 2020), and (Does et al., 2023), green product innovation influences competitive advantage, green dynamic capability influences green competitive advantage, and (Qiu et al., 2020) concluded green dynamic capability plays a significant role as a mediator in the relationship between green product innovation and competitive advantage. Participants complete a questionnaire using a Likert scale (1–5) to generate competitive advantage (Y), green product innovation (X), and green dynamic capabilities (M). The questionnaire includes theoretical indicators of each variable used, which consist of 15 items of green dynamic capability variables (Dangelico et al., 2017; Wang & Ahmed, 2007; Zhang et al., 2020), 3 items of green product innovation variables (Chang, 2019), and 6 items of competitive advantage variables (Chang, 2011; Porter & Linde, 1995; Qiu et al., 2020). In addition, the data analysis tool used in this study uses Smart PLS version 4.0.

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RESULTS AND DICUSSION

Descriptive Analysis

Data collection in this study, researchers used a questionnaire instrument that was distributed directly to the owner or manager/supervisor/person in charge of Bakery MSMEs in Padang City. This is because based on stakeholder theory (Yu et al., 2022), the owner or manager/supervisor/person in charge is a party who is directly involved and has an interest in the operation of bakery MSMEs so that MSMEs can be successful in preserving the environment. Respondent characteristics can be seen in the following table:

Table 1. Respondent Characteristics

Characteristic	Total	Persentage	Characteristic	Total	Persentage
Gender			**Position**		
Male	28	13%	Owner	92	44%
Female	182	87%	Manager/ Supervisor/ Person in Charge	118	56%
Age					
<25 years	9	4%			
25-40 years	138	66%	**Age of MSMEs**		
41-55 years	62	30%	<5 years	47	22%
>55 years	1	0,50%	5-10 years	114	54%
Education			11-20 years	40	19%
SD	1	0,50%	>20 years	9	4%
SMP	1	0,50%	**Number of employees**		
SMA/ SMK	171	81%	1-4 people	108	51%
Diploma	12	6%	5-19 people	97	46%
Bachelor	25	12%	20-99 people	6	3%
Master	0	0%	>100 people	0	0%

Source: Primary Processed Data (2025)

Data Analysis

Outer Model

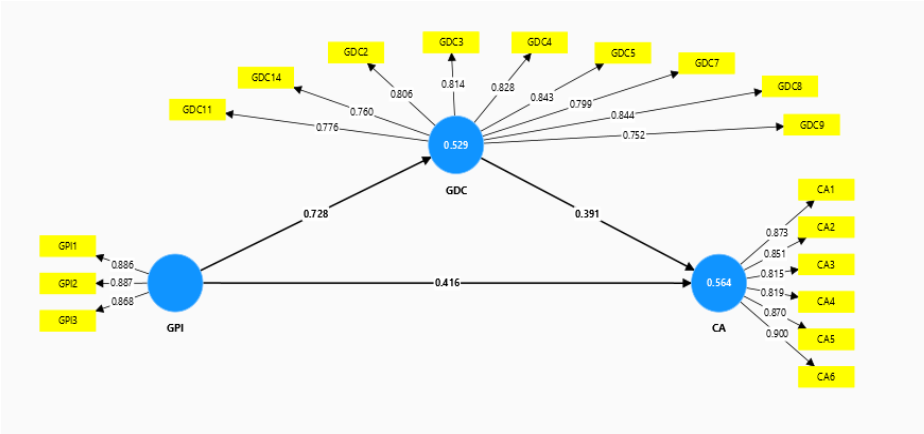

Figure 1. Outer Model

Source: SmartPLS 4, Year 2025

All indicators as construct measures have been shown to meet convergent validity because their values fall between 0.7 and 0.9, indicating that the construct of all variables after feminization in items GDC1, GDC 6, GDC 10, GDC 12, GDC 13, and GDC 15. This is evident from the loading analysis results table, which shows that the measurement of each research variable above has an outer loading ranging from 0.7 to 0.9. The Average Variance Extract (AVE) value for each construct is compared with the correlation between one construct and another in the model, and the Cronbach's alpha and composite reliability indicator block values are examined to measure the construct. The construct reliability and validity findings from the SmartPLS 4.0 output are as follows.

Table 2. Reliability and Validity Test

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CA	0,926	0,930	0,942	0,732
GDC	0,931	0,932	0,942	0,645
GPI	0,854	0,855	0,912	0,774

Source: SmartPLS 4, Year 2025

Based on table 2, the results of the composite reliability Cronbach's alpha can be said to be reliable if they have a value above 0.7 and it can be seen that all AVE values of the variables are above 0.5, which indicates that the convergent validation variables in this study are declared valid. Discriminant Validity ensures that the constructs being measured are truly distinct from each other, which confirms that each construct captures a unique concept that is not reflected in the others. One widely accepted method for assessing Discriminant Validity is the Fornell-Larcker criterion. This approach involves comparing the square root of the Average Variance Extracted (AVE) of each construct to the correlation between that construct and the others in the model. If the square root of the AVE is greater than the inter-construct correlation, it indicates that the construct has good Discriminant Validity. This step is important in structural equation modeling (SEM), as it confirms the reliability and accuracy of the measurement model in distinguishing between different latent variables.

Table 3. Fornell Larcker

	Competitive Advantage (Y)	Green Dynamic Capability (Z)	Green Product Innovation (X)
CA	0,855		
GDC	0,694	0,803	
GPI	0,701	0,728	0,880

Source: SmartPLS 4, Year 2025

Based on the table above, it shows that the correlation of variables to indicators is higher than the correlation of variables to other indicators. It is concluded that all indicators are stated to have discriminant validity based on the Fornell Larcker value.

Structural Model Test (Inner Model)

This structural model test is conducted to determine the relationship between variables, significant values and R-Square of the research model. This is done to see how much one variable influences other variables.

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Table 3. Inner Model

	R-square	R-square adjusted
CA	0,564	0,559
GDC	0,529	0,531

Source:
SmartPLS 4, Year 2025

Based on the table above, it can be explained that the Competitive Advantage variable can be explained by Green Product Innovation, Green Dynamic Capability by 56% and the remaining 44% is explained by variables not mentioned in this study, likewise the Green Dynamic Capability variable can be explained by Competitive Advantage, Green Product Innovation, by 53% the remaining 47% is explained by variables not mentioned in this study.

Hypothesis Test

After the above tests meet the criteria, the next step is to test the hypothesis using bootstrapping analysis. Hypothesis testing is conducted to see and determine the direct influence, indirect influence, and total influence between variables. This test is conducted by operating bootstrapping on the SmartPLS 4.0 program.

Tabel 4. Hypothesis Test

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P value
GPI -> CA	0,416	0,418	0,082	5,105	0,000
GPI -> GDC	0,728	0,728	0,032	22,473	0,000
GDC -> CA	0,391	0,390	0,084	4,665	0,000
GPI -> GDC -> CA	0,285	0,284	0,064	4,639	0,000

Source: SmartPLS 4, Year 2025

In the table 4, it can be seen that the results of the first hypothesis test show that the green product innovation variable with competitive advantage shows a t-statistic and p-value of 5.105 and 0.000, respectively. This value is greater than the t-table value (1.96) and less than 0.05. While the original sample value is 0.418, then H0 is rejected, H1 is accepted, which means that green product innovation has a positive and significant effect on competitive advantage. The results of the second hypothesis test show that the green product innovation variable with green dynamic capabilities shows a t-statistic and p-value of 22.473 and 0.000, respectively. This value is greater than the t-table value (1.96) and less than 0.05. While the original sample value is 0.728, then H0 is rejected, H2 is accepted, which means that green product innovation has a positive and significant effect on competitive advantage.

The results of the third hypothesis test show that the green dynamic capability variable with competitive advantage shows a t-statistic and p-value of 4.665 and 0.000, respectively. This value is greater than the t-table value (1.96) and less than 0.05. While the original sample value is 0.390, H0 is rejected, H3 is accepted, which means that green product innovation has a positive and significant effect on competitive advantage. The results of the fourth hypothesis test show that the green dynamic capability variable mediates between green product innovation and competitive advantage, showing a t-statistic and p-value of 4.439 and 0.000, respectively. This value is greater than the t-table value (1.96) and less than 0.05. While the original sample value is 0.284, H0 is rejected, H4 is accepted, which means that green product innovation has a positive and significant effect on competitive advantage mediated by green dynamic capability.

This study supports the finding that green product innovation can increase a company's competitive advantage in an environmentally friendly context, especially in bakery MSMEs in

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Padang City. This study proves that the implementation of green product innovation in bakery MSMEs in Padang City contributes to increasing environmental and economic value. This is because they have used environmentally friendly raw materials, technological efficiency, and reduced waste and emissions, which ultimately improve product quality while strengthening their brand image. These results are consistent with research by Abdelfattah et al., (2025), which found that a number of factors that boost a company's competitiveness in creating eco-friendly products can account for the positive correlation between green product innovation performance and the company's competitive advantage. The study's conclusions support the idea that developing green products increases consumer loyalty (Chang & Fong, 2010).

Businesses that are dedicated to sustainability have a better chance of drawing in and keeping eco-aware clients as consumer knowledge of environmental issues grows. Accordingly, a company's dedication to ethical environmental policies is reflected in its green product innovation, which eventually boosts competitive advantage and customer loyalty (Cronin et al., 2011). Furthermore, the research result by Chang, (2011), the positive relationship between green product innovation performance and the company's competitive advantage can be explained through various factors that support the company's competitiveness in developing environmentally friendly products. Businesses may not be able to innovate successfully or react quickly to changes in market demand if they do not have the necessary capabilities. By utilizing green product innovation, green dynamic capability can be developed and implemented successfully.

This study proves that green product innovation can increase the ability to reconfigure resources, absorb environmentally friendly information and also determine the direction of bakery MSMEs in the future. So, it can be concluded that green dynamic capability in Padang City's bakery MSMEs is significantly and favorably impacted by green product innovation. This is consistent with study by (Qiu et al., 2020), the development of green products has a favorable and noteworthy effect on the company's green dynamic capability, establishing a win-win situation in which innovation not only aids businesses in overcoming environmental obstacles but also fosters the growth of increased internal capacity for future innovation. Green product innovation can also change the way knowledge elements are reorganized and result in the expansion and reconstruction of knowledge by maintaining the product properties or characteristics of the original knowledge elements unchanged.

In addition, innovative companies can gain advantages as pioneers, attract new customers, improve understanding of new market trends, and the ability to take advantage of opportunities before competitors (Wilden et al., 2013). Green dynamic capabilities are needed for businesses to continuously develop, build, and refine their strategies. In addition, these capabilities enable companies to explore new areas that have not been explored by collecting and acquiring new resources and knowledge, expanding existing resources and knowledge, thereby expanding the range and depth of resources that can help companies achieve competitive advantage. Bakery MSMEs in Padang City have been able to seize opportunities and react quickly to environmental changes with green dynamic capabilities, which helps them gain sustainable competitive advantage. In addition, this study shows that businesses with strong green dynamic capabilities are more likely to successfully gain competitive advantage in markets where green innovation is becoming increasingly important.

This is consistent with research (Does et al., 2023) that demonstrates how green dynamic capability contributes significantly to green competitive advantage, allowing businesses to more effectively incorporate eco-friendly activities into their plans. Green dynamic capacity, according to Huang et al., (2024), can help businesses constantly adjust and reorganize their assets and capacities to meet shifting environmental possibilities and needs. So, bakery MSMEs in Padang City have been able to create competitive value for their products through the ability to integrate, build, and allocate resources related to environmental protection in achieving competitive advantage. In this study, green dynamic capability acts as a mediator between competitive

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advantage and green product innovation, meaning that green dynamic capability has a positive and significant impact on competitive advantage.

According to research by Qiu et al., (2020), green product innovation has a lot of potential to boost a business's competitive edge in the face of market dynamics that place an increasing emphasis on sustainability. Dynamic capabilities enable companies to recognize opportunities and threats, capitalize on potential advantages, and make the necessary changes to increase their ability to adapt to the environment—ultimately resulting in a stronger competitive advantage (Li & Liu, 2014). Businesses who offer eco-friendly products not only satisfy the demands of customers who are becoming more conscious of environmental issues, but they also improve their reputation. In terms of distinction, consumer loyalty, and favorable brand views, products created with an ecological approach can contribute a substantial amount of value. Furthermore, green dynamic capabilities and green product innovation assist MSMEs bakery in adhering to relevant environmental standards, which lowers operational and legal risks. Green product innovation is a crucial tactic for creating and preserving a sustainable competitive advantage because it combines market appeal with regulatory compliance.

CONCLUSION

With green dynamic capability mediating the relationship between the two variables, this study presents the findings of the impact of green product innovation on competitive advantage in Padang City's bakery MSMEs. 1) Green product innovation has a positive and significant effect on competitive advantage in bakery MSMEs in Padang City; 2) Green product innovation has a positive and significant effect on green dynamic capability in bakery MSMEs in Padang City; 3) Green dynamic capability has a positive and significant effect on competitive advantage in bakery MSMEs in Padang City; and 4) There is an indirect (mediation) and significant and positive influence between the relationship between green product innovation and competitive advantage with green dynamic capability acting as a mediator in bakery MSMEs in Padang City. These conclusions are based on the analysis and discussion in the previous section.

SUGGESTION

In order to gain a competitive edge, Padang City's bakery MSMEs must prioritize the use of environmentally friendly raw materials, such as organic or locally sourced materials devoid of dangerous chemicals, employ effective technology, and put sustainable production methods into place. The study's findings demonstrate that green product innovation, which is mediated by green dynamic capability, contributes to the competitive advantage of bakery MSMEs. This study's shortcoming is that it only looks at one kind of food MSME, specifically Padang City's bakery MSMEs. The researcher recommends that more people or other items be studied by future researchers.

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