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# Physicochemical Properties of Ambarella Fruit Leather with Variations in Gum Arab Concentration

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**Abstract**

*Fruit leather is a thin sheet product made from dried fruit pulp until it has a flexible texture and can be rolled. Ambarella was chosen as the raw material because it has a sour taste and is naturally rich in vitamin C. The elasticity of fruit leather is influenced by the type of binding agent used, one of which is gum arab. Gum arab is a polysaccharide from the sap of Acacia sp. that is stable at pH 2–7 and resistant to acidic conditions and high temperatures. This study aimed to determine the changes in physicochemical characteristics of ambarella fruit leather with the addition of gum arab at different concentrations. The formulation used five gum arab concentrations (0%, 0.6%, 0.8%, 1%, and 1.2%) and three replications. The process included preparing puree, mixing with sugar and gum arab, and drying into sheets. Parameters tested were moisture content, pH, total sugar, total soluble solids, vitamin C, crude fiber, thickness, and texture. The results showed chemical properties which are moisture content 14.10–17.08%; pH 3.09–3.47; sugar 20.00–20.02%; soluble solids 72.43–74.77%; vitamin C 5.57–12.61%; and crude fiber 1.58–2.23%. Physical properties such as thickness 1.27–1.31 mm; tensile strength 0.03–0.16 MPa; elongation 7.01–10.53%; hardness 13.66–78.85 N; gumminess 5.28–57.88 N; and chewiness 3.75–49.20 N. It can be said that the variations in gum arab significantly affected both chemical and physical properties of ambarella fruit leather is a healthy snack.*

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## 1. Introduction

Ambarella (*Spondias dulcis*) is a tropical fruit that is abundant in Indonesia. Ambarella is generally consumed as a fresh fruit, either whole or peeled, and is often used as an ingredient in fruit salads. Per 100 g of ambarella fruit contains 1.7 g of fiber, 11 g of carbohydrates, 5.1 g of glucose, 0.53 g of fat, 30 mg of vitamin C, 230 IU of vitamin A, 0.3 mg of iron, and 15 mg of calcium. These nutrients make ambarella suitable for processing into a nutritious fruit leather (Devi et al., 2024; Koubala et al., 2018). The sour taste of the ambarella fruit makes it unpopular with most people. This results in low market

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value and underutilization. Furthermore, the ambarella fruit spoils and rots quickly due to its high water content.

Using ambarella fruit as a raw material for fruit leather is one way to increase the fruit's economic value. Fruit leather is prepared by mashing the fruit into a pulp, mixing it with sugar and an emulsifier, and then drying it to form a thin, easy-to-roll sheet (Sarkar et al., 2020). Fruit leather is a processed fruit product with high nutritional value and vitamin content. Fruit leather has several advantages, including a long shelf life, easy production, and maintained nutritional value. Fruit leather is relatively easy to store because it does not require special treatments. Fruit leather has a shelf life of up to 12 months when packaged using the correct storage method, such as polyethylene packaging at room temperature–25-30˚C (Sharew & Woldemariam, 2025).

One challenge in producing fruit leather is maintaining elasticity so that it is not too hard or easily broken but remains flexible and can be rolled. An important factor influencing elasticity is the type of binder, such as gum arab, which functions as a flavor binder, film former, thickener, and emulsifier by combining the hydrophobic phase (oil, aromatic compounds) and the hydrophilic phase (Alam et al., 2024; Kurniadi et al., 2022; Peng et al., 2023). Gum arab as a stabilizer has several advantages, including being a natural stabilizer, having high stability, and being effective in protecting colloidal systems. Another advantage is that gum arab is highly soluble in water, with a solubility level of up to 95%; therefore, it is often used in the manufacture of products such as fruit leather (Kurniadi et al., 2022; Novelina et al., 2025). Gum arab, carboxymethyl cellulose (CMC), and carrageenan function as thickeners, stabilizers, emulsifiers, and gelling agents, but have different properties and stability. Gum arab is derived from the sap of the acacia tree, is easily soluble, heat-resistant, stable at pH 2–7, and hydrophilic, allowing it to bind water and retain vitamin C by inhibiting oxidation in acidic conditions (Chien et al., 2023; Prasad et al., 2022). CMC, a cellulose derivative, is soluble in both hot and cold water and stable at pH 5–11 (optimal pH 5); however, its viscosity decreases at pH <3, and it cannot protect vitamin C (Yudhistira et al., 2020). Carrageenan, obtained from red seaweed, is stable at mildly alkaline pH (approximately pH 9), easily degrades at pH <3.5, and cannot maintain the stability of vitamin C in acidic food products (Russo Spena et al., 2023).

## 2. Material and Methods

### 2.1 Material

The materials used in this research were ambarella fruit obtained from a traditional market in Yogyakarta, gum arab as an emulsifier, and sugar.

### 2.2 Amberella Fruit Leather Production

The production of ambarella fruit leather started with good quality fruit, which was determined by its firm texture (80 %) and yellow peel color. The Ambarella fruit was peeled, and the seeds were

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removed. The fruits were then washed and cut into small pieces. To produce the ambarella fruit puree, the flesh was ground using a blender. The resulting ambarella puree was added with 15% w/w of granulated sugar and gum arab stabilizer at varying concentrations of 0% (F1), 0.6% (F2), 0.8% (F3), 1% (F4), and 1.2% (w/w) (F5). The puree and other ingredients were mixed using a blender for 1 min. The fruit leather batter was molded using a silicone mat with a thickness of 3 mm. Drying was carried out using a cabinet dryer at 50°C for 10 h (Mardiyana et al., 2022; Setiaboma et al., 2019).

2.3 Moisture Content Analysis

The water content of the ambarella fruit leather was determined using the gravimetric method. The analytical balance was heated in an oven at 105°C for 30 min, then cooled in a desiccator for 15 min, and weighed. The fruit leather sample was cut into small pieces, weighed to 2 g, and placed on an analytical balance. Subsequently, the sample was dried in an oven at 105°C for 6 h. The analytical balance containing the sample was then cooled in a desiccator for 15 min and weighed. Moisture content was calculated using Equation (1) (AOAC, 2005; Novelina et al., 2025).

$$Water\ content\ (\%) = \frac{W2 - W3}{W2 - W1} \times 100\% \tag{1}$$

Where W1 is the weight of the empty cup (g), W2 is the weight of the cup and sample before drying (g), and W3 is the weight of the cup and sample after drying (g).

2.4 Total Sugar Analysis

Analysis of total sugar content of ambarella fruit leather using a spectrophotometric method with anthrone reagent. The reagent was prepared by dissolving 200 mg of anthrone in 100 cc of 95% $H_2SO_4$. For the standard curve, the glucose stock solution was diluted to 0–1 ml, mixed with 3 ml of reagent, heated for 10 min, and measured at 630 nm. The sample consisted of 2 g of fruit leather, which was crushed, dissolved in 50 ml of distilled water, filtered, and diluted to 100 ml with 10 ml. Next, 1 ml of the sample solution was mixed with 3 ml of anthrone reagent, heated for 10 min, and the absorbance was measured at 630 nm. Total sugar was calculated using Equations (2) and (3) (Sukasih & Widayanti, 2022).

$$Total\ sugar\left(\frac{mg}{g}\right) = Value\ (x)\ \times fp\ \times \frac{initial\ solution\ volume}{sample\ weight} \tag{2}$$

$$Value\ (x) = \frac{sample\ absorbance\ value - 0{,}0134}{0{,}7256} \tag{3}$$

2.5 Total Soluble Solids Analysis

The total soluble solids (TSS) analysis of the ambarella fruit leather was carried out using the gravimetric method. The empty cups were dried in an oven overnight, cooled in a desiccator, and then weighed to record their initial weight. A 3 g sample of fruit leather was placed in a cup and dried in

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an oven at 100°C for 4 h. The cup was then cooled in a desiccator and weighed to obtain the final weight. The total soluble solids were calculated using Equation (4) (Giovani et al., 2024).

$$Total\ dissolved\ solids\ (\%wb) = \frac{(W2-W)-(B1-B2)}{W1-W2} \times 100\% \quad (4)$$

Where W is the initial weight of the dish (g), W1 is the weight of the dish and sample before heating (g), W2 is the weight of the dish and sample after heating (g), B1 is the weight of the container before oven heating (g), and B2 is the weight of the container after oven heating (g).

2.6 Vitamin C Analysis

Vitamin C analysis of the ambarella fruit leather was conducted using the titration method. A 5 g sample of crushed fruit leather was diluted with distilled water (100 ml). Then, 10 mL of the filtrate was added to a starch indicator. Titration was conducted using 0.01 N iodine solution until the solution color changed to blue. The vitamin C value was calculated using Equation (5) (Andeswari et al., 2024; Rahmadhia et al., 2025).

$$Vitamin\ C\ \left(\frac{mg}{100g}\right) = \frac{(VI_2 \times 0{,}88 \times Fp) \times 100}{Ws\ (g)} \quad (5)$$

Where $VI_2$ is the iodine volume (ml), Fp is the dilution factor (1), and Ws is the sample weight (g).

2.7 Crude Fiber Analysis

The crude fiber analysis of the ambarella fruit leather was conducted using the Buchner method. A 1 g sample of ground fruit leather was added to 50 ml of 0.3 N $H_2SO_4$ and heated at 70°C for 1 h. Then, 50 ml of 1.5 N NaOH was added and heated for 30 min. The solution was filtered using a Buchner funnel with pre-weighed filter paper. The precipitate was washed successively with 0.3 N $H_2SO_4$, hot distilled water and 96% ethanol. The filter paper was dried in an oven at 105 °C for 1 h, cooled in a desiccator for 15 min, and then weighed until a constant weight was achieved. The crude fiber content was calculated using Equation (6) (Cvrk et al., 2022).

$$Crude\ fiber\ (\%) = \frac{((Wdry+filter)-Wfilter)}{Wo} \times 100\% \quad (6)$$

Where Wdry+filter is the weight of the dry residue and filter paper (g), Wfilter is the weight of the filter paper (g), and Wo is the sample weight (g).

2.8 pH Analysis

The pH of ambarella fruit leather was analyzed to determine product quality degradation. A 50 g sample of pre-dried fruit leather pulp was then prepared. The pH meter was calibrated with buffers of pH 4, 7, and 10, before use. The electrode was inserted into the sample, and the pH was read on the instrument display (Sharma et al., 2025; Umam et al., 2025).

2.9 Thickness Analysis

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Thickness analysis of the ambarella fruit leather was performed using a screw micrometer at five different points representing the entire thickness of the fruit leather. Subsequently, the fruit leather thickness was calculated as the average of the measurement results at these five points (Arifani & Tamalea, 2024).

### 2.10 Mechanical Properties Analysis

Tensile strength measurements were performed using the ASTM (1995) method with a Universal Testing Machine. The ambarella fruit leather was cut into 10×5 cm samples. The analysis was conducted in triplicate (Arifani & Tamalea, 2024).

### 2.11 Texture Analysis

The texture profile of the ambarella fruit leather was tested using a Texture Profile Analyzer. The sample was prepared to a size of 30×20 mm, and the thickness was 2–3 mm (Utomo & Rahmadhia, 2024).

### 2.12 Statistical Analysis

The resulting research data were processed using Microsoft Excel 2021. The data were statistically analyzed using SPSS with one-way Analysis of Variance (ANOVA). If significant differences were found between treatments, further testing was performed using Duncan's Multiple Range Test (DMRT) at the 0.05 level.

## 3. Results and Discussion

### 3.1 Moisture Content

The texture and shelf life of fruit pulp products depend on their moisture content. A lower moisture content extends the product shelf life (Vikanksha et al., 2025). Figure 1 depicts the ambarella fruit leather produced in this study. Table 1 shows that the ambarella fruit leather with different gum arab concentrations had considerable moisture changes. SNI No. 1718, 1996, limits fruit leather moisture to 25%. The moisture content test on ambarella fruit leather showed that gum arab concentration increases moisture content. The more water evaporates during drying, the lower is the product moisture content. If water cannot evaporate optimally at the same temperature and drying time, significant moisture content can result. Because gum arabic can bind water, but its binding capacity is poor, water is more easily lost during drying. Gum arabic has a lower water-binding ability than other hydrocolloids because its protein content interacts with and binds water molecules through functional groups (Kurniadi et al., 2022; Valenzuela & Aguilera, 2015).

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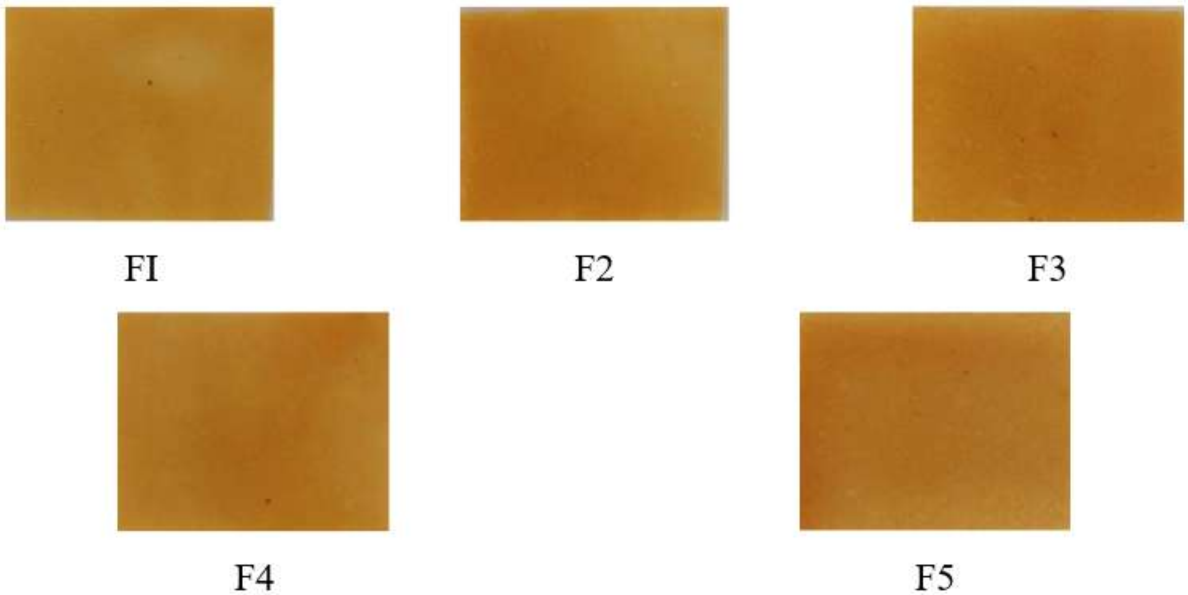


**Figure 1.** Ambarella fruit leather is a healthy snack

The correlation between the water content and water activity in fruit leather is nonlinear. Reducing the water content often decreases the water activity, leading to enhanced product density and flexibility. At a moderate moisture level (±10–20%) and water activity of 0.55–0.70, fruit leather demonstrates an ideal texture that is stretchy and non-brittle. Nevertheless, insufficient water content results in heightened stiffness and brittleness due to the diminished plasticizing effect of water on the polysaccharide matrix (Basdemir et al., 2024).

| Sample | Moisture content (%) | Total sugar (%) | Total dissolved solids (%) | Vitamin C (%) | Crude fiber (%) |
|---|---|---|---|---|---|
| F1 | 17.08 ± 0.34[c] | 19.99 ± 0.01[a] | 72.43 ± 0.03[a] | 5.57 ± 0.51[a] | 1.58 ± 0.14[a] |
| F2 | 16.92 ± 0.06[c] | 20.01 ± 0.00[ab] | 72.58 ± 0.04[b] | 9.68 ± 0.88[b] | 1.79 ± 0.03[ab] |
| F3 | 15.78 ± 0.64[b] | 20.01 ± 0.01[ab] | 74.51 ± 0.05[c] | 10.56 ± 0.88[bc] | 1.95 ± 0.04[bc] |
| F4 | 14.40 ± 0.56[a] | 20.01 ± 0.04[bc] | 74.62 ± 0.04[d] | 11.15 ± 0.51[c] | 1.96 ± 0.04[bc] |
| F5 | 14.10 ± 0.37[a] | 20.02 ± 0.00[c] | 74.77 ± 0.03[e] | 12.61 ± 0.51[d] | 2.23 ± 0.34[c] |

Note: Different letters following the values indicate significant differences at the 95% confidence level ($\alpha$ = 0.05). F1 (0%:100%), F2 (0.6%:99.4%), F3 (0.8%:99.2%), F4 (1%:99%), and F5 (1.2%:98.8%).

3.2 Total Sugar

Total sugars in the diet include reducing and non-reducing carbohydrates, such as monosaccharides, disaccharides, oligosaccharides, and polysaccharides (Kurzyna-Szklarek et al., 2022). Total sugar analysis of ambarella fruit leather with different gum arab concentrations showed a considerable difference (Table 1). The total sugar content of the ambarella fruit leather was the highest in sample F5 and the lowest in sample F1. The incorporation of gum arab (polysaccharides)

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elevated the overall sugar content of the fruit leather. Polysaccharides are large, non-reducing molecules composed of several monosaccharide units linked by glycosidic bonds. Hydrolysis liberates monosaccharide units, augmenting the overall sugar content of polysaccharides, regardless of their palatability. Polysaccharides are related to total sugars because they degrade into simple sugars that are analyzed (Hu et al., 2024; Yue et al., 2022).

### 3.3 Total Soluble Solids

Total soluble solids measure the amount of a material or component, including minerals, in a solution. The measurement results describe the total concentration of the dissolved substances in the sample. The analysis of total soluble solids in the fruit leather revealed substantial variances among the samples, ranging from 72.43% to 74.77%. Increasing the concentration of gum arab causes an increase in the total dissolved solids value in ambarella fruit leather. The increase in total soluble solids value is in line with the decrease in water content (Table 1). The lower the water content, the fewer the dissolved substances in the material, and the total soluble solids value tends to decrease. The stabilizer binds to free water in the medium, increasing the total dissolved solids. More stabilizer-bound particles indicate a higher total dissolved solid content (Alam et al., 2024; Giovani et al., 2024; Mousavi et al., 2025).

The stabilizer captures the suspended particles in the solution, inhibiting their sedimentation. The increase in gum arab concentration, which enhances the total dissolved solids content of the material, is attributable to its capacity to absorb water and dissolved substances. Consequently, the incorporation of substantial quantities of gum arab increases the total dissolved solids concentration in the fruit leather (Kawhena et al., 2021; Raj & Dash, 2022).

### 3.4 Vitamin C

Vitamin C, also known as ascorbic acid, is a water-soluble molecule consisting of six carbon atoms. This chemical is essential for the body's defense mechanism, particularly in countering reactive oxygen species in plasma and cells. Iodometric titration was employed to assess vitamin C via a redox reaction that incorporates iodine. The quantity of unreacted iodine was determined by adding a starch indicator to monitor the color change (Gęgotek & Skrzydlewska, 2022; Spínola et al., 2013).

Table 1 indicates that gum arab significantly influenced the vitamin C content of the ambarella fruit leather at various doses. It can be inferred that increased concentrations of gum arab correlate with elevated vitamin C levels in ambarella fruit leather, based on the highest vitamin C content observed. Elevated concentrations of gum arab influenced the vitamin C content in the fruit leather. Gum arab can create a protective barrier, retain water and water-soluble substances such as vitamin C, and function as a thickening and stabilizing agent. These characteristics prevent the oxidative degradation of ascorbic acid (Kurniadi et al., 2022). Ascorbic acid, often known as vitamin C, has the chemical formula $C_6H_8O_6$. This lactone derivative of gluconic acid features a furanose ring with enediol groups

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at C-2 and C-3. The enediol group makes ascorbic acid reactive and a potent reducing agent, rapidly oxidizing it to dehydroascorbic acid. The redox properties of vitamin C render it a natural antioxidant and facilitate its identification through chemical analysis (Gęgotek & Skrzydlewska, 2022).

3.5 Crude Fiber

The crude fiber content increased with the addition of gum arab to the ambarella fruit leather formulation. The crude fiber content of the ambarella fruit leather varied between 1.58% and 2.23% (Table 1). Gum arab comprises water-soluble fibers capable of creating a viscous solution or gel matrix upon dissolution in water (Basdemir et al., 2024). Gum arab contains natural sugars, and its elevated fiber level may result from its complex polysaccharide structure, which is challenging to digest (Suresh et al. 2022). The crude fiber value in this study was comparable to that of guava fruit leather enhanced with gum arab, which also exhibited a similar increase. The crude fiber content of the flour ranged from 1.78% to 2.32% (Fachriah & Rahmawati, 2022).

3.6 pH

Gum arab contains glucuronic acid, a weak acid characterized by a carboxyl group. This group produces gum arab, which is water-soluble and mildly acidic, resulting in a colloidal solution. Gum arab functions as a gel-forming hydrocolloid and stabilizer in fruit leather. Glucuronic acid regulates the texture, moisture, and stability of fruit leather. Its acidic properties decrease the pH, thereby preserving and souring it (Fachriah & Rahmawati, 2022; Taheri & Jafari, 2019).

Table 2 indicates that the pH value of the ambarella fruit leather considerably decreased with increasing quantities of gum arab. The low pH is additionally affected by ambarella fruit, which possesses a pH of 3.8, signifying its acidic flavor (Candido et al., 2024; Winokan et al., 2022). Additionally, gum arab serves as a stabilizer, binding water and dissolved organic acids throughout the drying process. The greater the binding of organic acids, the lower the pH of the fruit leather. The organic acids in the ambarella fruit leather are derived from vitamin C present in the fruit (Alam et al., 2024; Smith et al., 2022).

**Table 2.** pH and thickness of ambarella fruit leather is a healthy snack

| Sample | pH | Thickness (mm) |
|---|---|---|
| F1 | $3.47 \pm 0.14^{c}$ | $1.28 \pm 0.03^{a}$ |
| F2 | $3.39 \pm 0.08^{bc}$ | $1.27 \pm 0.05^{a}$ |
| F3 | $3.29 \pm 0.03^{abc}$ | $1.28 \pm 0.02^{a}$ |
| F4 | $3.26 \pm 0.02^{ab}$ | $1.28 \pm 0.03^{a}$ |
| F5 | $3.09 \pm 0.17^{a}$ | $1.31 \pm 0.04^{a}$ |

Note: Different letters following the values indicate significant differences at the 95% confidence level ($\alpha = 0.05$). F1 (0%:100%), F2 (0.6%:99.4%), F3 (0.8%:99.2%), F4 (1%:99%), and F5 (1.2%:98.8%).

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3.7 Thickness

Gum arab had no significant effect on the thickness of the ambarella fruit leather (Table 2). The thickness of the ambarella fruit leather in the present study varied from 1.27 to 1.31 mm. The negligible thickness of the fruit leather was determined based on the consistency of the volume of the fruit leather mixture prior to drying. A consistent volume yields an approximately homogeneous thickness. Fruit leather is a compact, elastic, and non-adhesive sheet with a moisture content ranging from 10% to 25% and a thickness of 1–3 mm (Febrianti et al., 2023). Consequently, the thickness of the fruit leather in this study complied with the established requirements.

3.8 Mechanical Properties

Table 3 indicates that the tensile strength of the ambarella fruit leather significantly increased with the addition of gum arab to the formulation. The tensile strength of the ambarella fruit leather varied between 0.03 and 0.16 MPa. The development of a flexible texture in fruit leather is affected by elements such as pectin, sugar, and stabilizers. This is because these three components can create a gel during heating. The limited capacity of gum arab to retain water contributes to the heightened flexibility of the fruit leather (Amid et al., 2013; Xiang et al., 2024).

**Table 3.** Mechanical and texture profile of ambarella fruit leather is a healthy snack

| Sample | Tensile Strength (MPa) | Elongation (%) | Hardness (N) | Gumminess (N) | Chewiness (N) |
|---|---|---|---|---|---|
| F1 | 0.03 ± 0.01$^{a}$ | 7.93 ± 0.60$^{ab}$ | 78.85 ± 9.19$^{c}$ | 57.88 ± 11.33$^{d}$ | 49.20 ± 8.20$^{d}$ |
| F2 | 0.06 ± 0.01$^{b}$ | 8.74 ± 0.53$^{bc}$ | 66.59 ± 9.38$^{c}$ | 43.16 ± 6.19$^{c}$ | 38.00 ± 7.55$^{c}$ |
| F3 | 0.08 ± 0.01$^{c}$ | 10.53 ± 0.93$^{d}$ | 46.30 ± 8.64$^{b}$ | 28.47 ± 7.66$^{b}$ | 24.72 ± 7.09$^{b}$ |
| F4 | 0.12 ± 0.00$^{d}$ | 7.01 ± 1.07$^{a}$ | 13.66 ± 1.40$^{a}$ | 5.28 ± 0.43$^{a}$ | 3.75 ± 0.40$^{a}$ |
| F5 | 0.16 ± 0.05$^{e}$ | 9.65 ± 0.64$^{cd}$ | 33.49 ± 4.92$^{b}$ | 18.48 ± 3.53$^{b}$ | 15.47 ± 3.66$^{b}$ |

Note: Different letters following the values indicate significant differences at the 95% confidence level ($\alpha$ = 0.05). F1 (0%:100%), F2 (0.6%:99.4%), F3 (0.8%:99.2%), F4 (1%:99%), and F5 (1.2%:98.8%).

The increased tensile strength of the fruit leather correlated with a reduction in its moisture content. The gel formation process involves cross-linking among polymer chains, yielding a continuous three-dimensional network. This network can entrap water molecules within the gel matrix, binding the water and rendering it unavailable as free water. Consequently, throughout the drying process, water is more readily expelled from the product surface, although some moisture remains confined within the gel matrix. This results in a reduction in the overall water content of the product, while simultaneously enhancing the density and stability of the fruit leather structure (Fachriah & Rahmawati, 2022; Hashem et al., 2025).

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Table 3 indicates that the elongation value of the ambarella fruit leather fluctuated. Elongation determines the extent to which a product can be extended under tensile strain; a higher elongation value signifies increased flexibility. The increase in gum arab concentration markedly influenced the elongation value of the ambarella fruit leather as a healthy snack. Nonetheless, at F4, the elongation diminished. This was due to the phenomenon of anti-plasticization. Anti-plasticization is a phenomenon in which supplementary materials, such as plasticizers intended to enhance flexibility, result in a rigid and dense fruit leather due to inadequate quantities. This may enhance the tensile strength while diminishing the flexibility of the fruit leather (Nurhadi et al., 2023).

3.9 Texture

The textural characteristics of the ambarella fruit leather were significantly influenced by the incorporation of gum arab (Table 3). The hardness of the ambarella fruit leather declined, along with reductions in gumminess and chewiness scores. Increasing the hydrocolloid concentration enhanced the texture by rendering it denser and more pliable. The reduction in hardness indicates that the leather has become more fragile (Chen et al., 2024).

The gumminess parameter quantifies the energy required to chew and disintegrate semi-solid food until it reaches a swallowable consistency. The gumminess scale is correlated with the hardness value. As the hardness value decreases, the gumminess value also decreases (Yusof et al., 2019).

The chewiness of the ambarella fruit leather was considerably affected by the presence of gum arab. Chewiness is a crucial factor in evaluating the texture of fruit leather, as it indicates the ease with which a product can be chewed and consumed. The chewiness attribute is affected by moisture levels, with reduced moisture content leading to a greater degree of chewiness. Water acts as a plasticizer within the polysaccharide matrix (pectin, fiber, and sugar). As the water concentration decreases, the molecular mobility declines, leading to a denser and more elastic configuration. This yields a chewier texture, in contrast to items with elevated water content, which are typically soft or mushy. A reduction in water content enhances the hydrogen interactions among pectin, sugar, and fiber. These linkages enhance the fruit leather gel network, yielding a denser and more elastic texture, which is the primary attribute of a chewy product (Nurhadi et al., 2023; Rodrigues et al., 2023).

## 4. Conclusion

The addition of varying concentrations of gum arab to the ambarella fruit leather formulations significantly affected the chemical and physical properties, except for the thickness of the fruit leather. The optimal formulation was F5 because of its superior physical properties. Ambarella fruit leather F5 had a texture that was neither hard nor rubbery, while exhibiting the highest vitamin C concentration among all formulations.

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