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THE EFFECT OF OYSTER MUSHROOM TO MIREPOIX RATIO ON THE PHYSICAL PROPERTIES AND SENSORY QUALITY OF MUSHROOM SEASONING POWDER

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Abstract

This study aimed to investigate the effect of oyster mushroom (Pleurotus ostreatus) to mirepoix ratio on the physical properties and sensory quality of mushroom seasoning powder as a natural alternative to monosodium glutamate (MSG). The study was motivated by the growing consumer demand for healthier, natural food products and the persistent problem of post-harvest surplus of oyster mushrooms at the farm level. An experimental method was employed with three ratio treatments of oyster mushroom to mirepoix namely 70:30, 60:40, and 50:50 alongside a control treatment (100:0). Physical properties assessed included acidity (pH) and total dissolved solids (°Brix), while sensory quality evaluation covered color, oyster mushroom aroma, mirepoix aroma, umami taste, oyster mushroom taste, and texture, tested under both dry and dissolved conditions. Validation testing was conducted by five expert panelists and sensory quality testing by 45 semi-trained panelists. Data were analyzed using one-way ANOVA for physical properties and the Kruskal-Wallis test for sensory quality, followed by post-hoc tests where significant effects were found. Results indicated that the ratio significantly affected pH ($F_{count} = 174.889 > F_{table} = 4.066$) but had no significant effect on °Brix. The 70:30 formulation yielded the optimal sensory profile: pale yellow-cream color, dominant mushroom aroma and taste, strong umami, fine powder texture, and pH closest to neutral.

Keywords: Mirepoix, Mushroom Seasoning Powder, Oyster Mushroom, Physical Properties, Sensory Quality

INTRODUCTION

The global demand for safe, healthy, and naturally derived food products has increased significantly in recent decades, driven by growing awareness of healthy lifestyles and heightened scrutiny of food additives. Flavoring agents particularly synthetic flavor enhancers have come under increasing consumer concern as awareness of their health implications broadens. Monosodium glutamate (MSG) remains the most widely consumed synthetic umami enhancer worldwide; national survey data from Indonesia's Riskesdas 2018 report indicate that approximately 77.6% of the Indonesian population regularly consume MSG as part of their daily diet (Feranika & Dewi, 2023). This high penetration rate reflects both the dominance of

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MSG in household and industrial cooking and the substantial scale of opportunity for substitution with natural alternatives that can deliver comparable or superior sensory outcomes (Amaliah et al., 2024).

Against this backdrop, food scientists and culinary researchers have turned increasing attention to mushroom-based seasoning powders as a promising category of natural umami enhancers. Oyster mushroom (Pleurotus ostreatus) has attracted particular interest because of its well documented content of free glutamic acid the primary biochemical driver of umami perception alongside high protein content (19–35%), dietary fiber (8–11.5%), low fat (1.7–2.2%), and various bioactive compounds including β-glucans and ergosterol that contribute both sensory and functional value (Dwi Anissa et al., 2021; Khalimatur Rahmah & Kholifatuddin Sya, 2023). Scientifically, the umami potency of oyster mushroom derives from a synergy between its free glutamic acid content and 5′-ribonucleotides (GMP, IMP, AMP) that create a multiplicative umami enhancement effect, making the perceived intensity of savory taste far greater than either compound alone (Tagkouli et al., 2020).

Oyster mushroom also holds a strategic position in Indonesia's agricultural economy: it constitutes approximately 55–60% of total national mushroom production, making it the dominant cultivated fungal commodity. Despite this scale of production, post-harvest management remains a challenge at the farm level. In Sukabumi Regency alone, a documented monthly surplus averaging 90 kg goes unutilized because fresh mushrooms are highly perishable and cannot be absorbed by local markets at peak production (Kuntari & Fitriani, 2021). Conversion of fresh oyster mushrooms into dried seasoning powder extends shelf life substantially, increases commercial value per kilogram, and reduces post-harvest losses benefits that extend to both the farming household and the broader supply chain. Evidence from community empowerment programs further supports this potential: a training initiative in Desa Boto, Klaten, successfully established new cottage industries for mushroom seasoning powder production, demonstrating its socioeconomic viability (Purnomo et al., 2022).

Figure 1. Oyster Mushroom
Source : Personal Documentation

Mirepoix the classical culinary aromatic base consisting of onion (50%), carrot (25%), and celery (25%) by weight represents an internationally recognized flavor-building foundation in continental cuisine. Gozali (2020) describes mirepoix as the essential “aromatic flavor base” that gives stock, sauces, and seasoning preparations their characteristic depth and roundness. Its culinary function rests on the synergistic chemistry of its three components: onion contributes sulfur-containing volatile compounds that generate sweet-savory complexity upon drying; carrot provides natural sugars, β-carotene, and a mild sweetness that counterbalances dominant savory notes; and celery supplies terpenoid volatile oils that add fresh, slightly herbal aromatic notes. Importantly, the mirepoix components also contribute organic acids and natural amino acids that may interact with free glutamate from mushrooms to produce an umami synergy effect, producing a richer and more complete flavor profile than mushroom powder alone.

Figure 2. Mirepoix
Source : Personal Documentation

From a food technology perspective, the drying process is a critical intervention in converting fresh ingredients into stable powders. The dehydrator temperature range of 40–60°C has been established as optimal for producing seasoning powders based on mushrooms: this range removes moisture efficiently without thermally degrading protein structures, volatile flavor compounds, or essential amino acids that contribute to sensory quality (Prasetyaningsih et al., 2018). Maillard reactions that occur at these temperatures generate additional flavor-active compounds that further enhance the savory and aromatic character of the final powder.

Despite growing interest in natural seasoning products and considerable research on individual components, limited peer-reviewed research has specifically examined the combined effect of oyster mushroom-to-mirepoix ratio on both physical properties and sensory quality of the resulting seasoning powder. The present study addresses this gap through a systematic experimental investigation. A pure oyster mushroom control treatment (100:0) was included to isolate and quantify the specific contribution of mirepoix addition to product quality changes. The primary objectives of this research are: (1) to determine whether varying the oyster mushroom-to-mirepoix ratio significantly affects physical properties specifically acidity (pH) and total dissolved solids (°Brix) of mushroom seasoning powder; and (2) to identify the ratio that yields the best overall sensory quality across dry and dissolved evaluation conditions, as measured through expert validation and semi-trained panel assessments.

METHOD

Research Design

This study employed a single-factor experimental design with four treatment levels of oyster mushroom-to-mirepoix ratio: Control (100:0), P1 (70:30), P2 (60:40), and P3 (50:50). The mirepoix component was compounded at a fixed internal ratio of 2:1:1 by weight (onion:carrot:celery) following the classical culinary standard (Gisslen, 2007). An additional constant ingredient food-grade salt was added at 20% of the total powder weight across all treatments, consistent with Kadaryati et al. (2021), who established that salt addition within the 25–37% range of non-mushroom pelengkap components enhances panel acceptance by reinforcing umami perception without dominating the overall flavor. Research was conducted at the Food Processing Laboratory, Program Studi Pendidikan Tata Boga, Fakultas Teknik, Universitas Negeri Jakarta, from January 2025 to May 2026.

Raw Material Preparation

Each raw ingredient was individually sourced, inspected for freshness and quality, cleaned, and processed independently to ensure compositional integrity. Oyster mushroom (Pleurotus ostreatus) was washed under running water and trimmed to remove the tough basal stem. Carrot (Nantes-type, Daucus carota L.) and onion (Allium cepa L.) were peeled. Celery (Apium graveolens var. dulce) stems only were used leaves were excluded to prevent excessive chlorophyll contribution that would shift the final powder color toward green and reduce visual appeal.

Figure 3. Dehidrating Carrot
Source : Personal Documentation

Figure 4. Dried Oyster Mushroom
Source : Personal Documentation

All prepared ingredients were sliced to a uniform small size to maximize surface area exposure and promote even drying. Each ingredient was then independently dehydrated using a food dehydrator at 40–60°C for 10–24 hours until a stable dry texture and consistent weight were achieved. Prasetyaningsih et al. (2018) confirmed that this temperature range preserves protein, fat, carbohydrate, and dietary fiber content without significant thermal degradation. After drying, each ingredient was independently ground using a grinder and sieved sequentially through mesh 80 followed by mesh 100 to ensure uniformly fine particle size distribution. Powders were stored separately in airtight containers until formulation.

Figure 5. Oyster Mushroom Powder
Source : Personal Documentation

Figure 6. Dried Mirepoix
Source : Personal Documentation

The four formulations were prepared by weighing and mixing the individual powders according to each treatment ratio, then incorporating the salt component. Blind product codes were assigned: 208 (P1, 70:30), 615 (P2, 60:40), and 947 (P3, 50:50); the Control was labeled separately for expert validation but withheld during semi-trained panel testing.

Physical Property Testing

Two physical properties were measured: acidity (pH) and total dissolved solids (°Brix). For each, 4 g of each powder formulation was dissolved in 400 mL of distilled water and homogenized to form a uniform suspension. pH was measured using a calibrated digital pH meter (calibrated with standard buffer solutions at pH 4.00 and 7.00) with triplicate readings recorded per treatment. Total dissolved solids were measured using a digital refractometer (2 g dissolved sample), with readings recorded in °Brix as triplicate means. Calibration of the refractometer was performed with distilled water before each measurement session. All measurements were performed in triplicate (r = 3) for each of the four treatments (t = 4), giving a total of 12 observations per parameter.

Sensory Evaluation

1. Expert Validation Testing

Expert validation was conducted first to confirm that the four formulations could be meaningfully distinguished by trained evaluators, and to verify that the descriptive sensory scales used in the instruments were appropriate. Five expert panelists all lecturers specializing in food science and culinary education at UNJ who had extensive professional experience with sensory evaluation evaluated all four treatment samples under both dry and dissolved conditions (0.25 g powder in 25 mL distilled water). Six sensory attributes were assessed: color, oyster mushroom aroma, mirepoix aroma, umami taste, oyster mushroom taste, and texture. Each attribute was scored on a 5-point descriptive scale specific to the product category (e.g., color scale: 5 = pale cream-yellow, 4 = deep cream-yellow, 3 = soft ochre-cream, 2 = light earth-cream, 1 = deep ochre-cream). Results were reported as frequency distributions and means by attribute and treatment.

2. Quality Testing by Semi-Trained Panelists

The main sensory quality testing phase was conducted by 45 semi-trained panelists who were undergraduate students at UNJ enrolled in or having completed the Sensory Evaluation course, ensuring familiarity with evaluation procedures and use of descriptive scales. Panelists were randomly assigned to three groups of 15 (one group per treatment), each evaluating only one coded sample under blinded conditions to avoid bias from cross-treatment comparison.

Evaluation was conducted in separate evaluation booths under standardized lighting, with samples presented at consistent temperature and concentration. The same six sensory attributes and 5-point scales used in expert validation were employed.

Statistical Analysis

Physical property data (pH, °Brix) were analyzed using one-way Analysis of Variance (ANOVA) at $\alpha = 0.05$. The standard ANOVA sequence was followed: computation of the Correction Factor ($CF = T_{ij}^2 / (r \times t)$), Sum of Squares Total (SST), Sum of Squares Treatment (SSP), and Sum of Squares Error ($SSE = SST - SSP$), yielding the Mean Squares for Treatment (MSP) and Error (MSE) and the F_{count} ratio. Where $F_{count} > F_{table}$ at df = $(t-1, r\times t-1) = (3, 8)$, Duncan's Multiple Range Test (DMRT) was applied as post-hoc analysis to identify which specific treatment pairs differed significantly.

Sensory quality data, which are ordinal and do not satisfy parametric assumptions, were analyzed using the Kruskal-Wallis non-parametric test at $\alpha = 0.05$. The test statistic $H = [12 / (N(N+1))] \times \Sigma(T_j^2/n_j) - 3(N+1)$ was calculated for each attribute, and compared against the chi-square critical value χ^2_{table} (df = 2, $\alpha = 0.05$) = 5.991. Where $H > 5.991$, Tukey's post-hoc pairwise Q-test was applied to identify which treatment pairs differed significantly, using $Q_h > Q_t = 3.42$ (at $\alpha = 0.05$, k = 3) as the significance criterion.

RESULTS AND DISCUSSION

Expert Validation Testing

Expert validation results are summarized in Table 1 and Table 2. Under dry conditions, the 70:30 formulation consistently achieved the highest mean scores across color (mean = 4.6), oyster mushroom aroma (mean = 4.6), oyster mushroom taste (mean = 4.2), and texture (mean = 5.0 the maximum possible score). The 60:40 formulation achieved the highest score for mirepoix aroma (mean = 4.2). A notable finding from validation was the umami taste attribute under dry condition: the 50:50 treatment received the highest expert score (mean = 4.6), marginally above the 70:30 (mean = 4.4), suggesting that a more balanced mushroom-to-mirepoix ratio may create a synergistic umami enhancement at the equal-proportion level that the 60:40 transition disrupted.

Table 1. Summary of expert validation results by attribute and condition (n = 5 expert panelists)

Attribute	Condition	70:30	60:40	50:50
Color	Dry	4.6	3.6	3.0
Oyster mushroom aroma	Dry	4.6	4.2	3.2
Mirepoix aroma	Dry	3.6	4.2	4.0
Umami taste	Dry	4.4	3.8	4.6
Oyster mushroom taste	Dry	4.2	3.8	3.2
Texture	Dry	5.0	4.8	4.8
Color	Dissolved	4.0	3.8	3.6

Attribute	Condition	70:30	60:40	50:50
Oyster mushroom aroma	Dissolved	4.6	3.8	4.2
Mirepoix aroma	Dissolved	3.6	3.8	4.4
Umami taste	Dissolved	3.4	3.6	4.2
Oyster mushroom taste	Dissolved	4.6	4.2	4.2
Texture (clarity)	Dissolved	3.2	3.4	3.2

Scores on 5-point descriptive scales. Score $\geq$ 4.0 meets the minimum quality standard set by the researcher.

Under dissolved conditions, the 70:30 treatment continued to lead on oyster mushroom aroma (mean = 4.6) and oyster mushroom taste (mean = 4.6). The 50:50 treatment produced the highest dissolved umami score (mean = 4.2) and the strongest mirepoix aroma (mean = 4.4) in the dissolved state. The texture (clarity of dissolution) attribute showed relatively low scores across all treatments (range 3.2–3.4), indicating that all formulations produced slightly turbid solutions with some particulate matter, which is expected for minimally processed ingredient-based powders without added emulsifiers or clarifying agents.

These validation results confirmed that the four treatments were meaningfully distinguishable and that the 70:30 ratio produced the most consistently high scores across mushroom-forward attributes (color, mushroom aroma, mushroom taste) while the 50:50 ratio showed a specific advantage for dissolved-state umami and mirepoix aroma. These findings guided the interpretation of the larger-scale sensory quality testing results presented below.

Sensory Quality Testing Dry Condition

Main sensory quality testing (n = 45 semi-trained panelists, 15 per treatment) revealed significant Kruskal-Wallis effects for three of six attributes under dry evaluation conditions (Table 2). Color, umami taste, and oyster mushroom taste each showed H values exceeding the critical threshold (χ^2 = 5.991), while oyster mushroom aroma, mirepoix aroma, and texture did not reach significance.

Table 2. Kruskal-Wallis test results for sensory quality attributes under dry and dissolved conditions

Attribute	Condition	H-value	χ^2 table (df=2)	Decision
Color	Dry	6,57	5.991	Significant
Oyster mushroom aroma	Dry	3,793	5.991	Not significant
Mirepoix aroma	Dry	1,424	5.991	Not significant
Umami taste	Dry	6,72	5.991	Significant
Oyster mushroom taste	Dry	10,812	5.991	Significant
Texture	Dry	1,296	5.991	Not significant
Color	Dissolved	0,5667	5.991	Not significant
Oyster mushroom aroma	Dissolved	12.92	5.991	Significant
Mirepoix aroma	Dissolved	1.399	5.991	Not significant
Umami taste	Dissolved	1.450	5.991	Not significant
Oyster mushroom taste	Dissolved	16.381	5.991	Significant
Texture (clarity)	Dissolved	0.223	5.991	Not significant

* H-values for dry-condition significant attributes to be completed from primary SPSS/manual calculation output. — = not significant (H < 5.991).

1. Color (Dry Condition)

Under dry conditions, the 70:30 treatment achieved a mean color score of 4.6 (pale cream-yellow), with 80% of panelists (n=12) assigning the highest scale score. Mean color scores decreased progressively as mirepoix proportion increased: 70:30 (mean = 4.6) > 60:40 (mean = 3.6) > 50:50 (mean = 3.0). This monotonic trend reflects the differential pigmentation contributions of the formulation components. At higher mushroom proportions, the dominant color signal comes from the pale cream-beige of dried oyster mushroom powder; as mirepoix proportion increases, the β-carotene pigments from carrot and the chlorophyll pigments from celery increasingly shift the powder color toward deeper ochre-orange or greenish hues. The observation that 80% of panelists scored the 70:30 treatment at the highest color level, while 53.3% of panelists scored the 50:50 treatment at the third-level color descriptor (soft ochre-cream), confirms that the color differences were perceptible and meaningful to semi-trained evaluators. Maulidia & Pujilestari (2025) reported a similar positive correlation between mushroom proportion and perceived powder brightness in oyster mushroom-based seasoning formulations.

2. Umami Taste (Dry Condition)

Umami taste under dry evaluation showed a significant Kruskal-Wallis effect, with Tukey's post-hoc analysis revealing that P1 (70:30) differed significantly from P3 (50:50), while P1 and P2 (60:40) did not differ significantly. The 70:30 treatment was rated highest for dry-condition umami, consistent with the positive relationship between mushroom proportion and free glutamic acid concentration. Oyster mushroom contains free glutamic acid at levels sufficient to produce measurable umami intensity when consumed in powdered form (Tagkouli et al., 2020). The direct contact of the dry powder with the tongue's taste receptors during dry evaluation amplifies the perception of water-soluble compounds that are concentrated in the dry matrix, which explains why higher mushroom content translates directly to stronger umami perception in this condition.

3. Oyster Mushroom Taste (Dry Condition)

The oyster mushroom taste attribute followed a similar pattern to umami taste, with 70:30 scoring significantly higher than 50:50, while 70:30 and 60:40 did not differ significantly. This is mechanistically consistent: the characteristic flavor compounds of oyster mushroom primarily free amino acids including glutamic and aspartic acid, plus the volatile compound 1-octen-3-ol which contributes the distinctive earthy-mushroom note are present in greater concentrations when the mushroom-to-mirepoix ratio is higher (Rosmiah et al., 2020). The threshold at which mirepoix components mask the characteristic mushroom flavor appears to be reached between the 60:40 and 50:50 ratios, as the transition from non-significance (P1 vs P2) to significance (P1 vs P3) confirms.

4. Non-Significant Attributes: Aroma, Mirepoix Aroma, and Texture (Dry)

Oyster mushroom aroma, mirepoix aroma, and texture did not reach statistical significance under dry conditions. The non-significance of mushroom aroma in the dry state may reflect limitations of olfactory perception when volatile compounds are bound within a dry matrix aroma is most effectively released into the olfactory epithelium when dissolved in water or fat. Similarly, mirepoix aroma at these formulation ratios may not be sufficiently concentrated to produce perceivable differences between treatments in the dry state. Texture showed uniformly high scores across all treatments (means 4.8–5.0 in validation), confirming that the double-sieving process (mesh 80 followed by mesh 100) effectively standardized particle size across treatments, eliminating texture as a differentiating variable.

Sensory Quality Testing Dissolved Condition

Under dissolved evaluation (0.25 g powder in 25 mL warm water simulating soup/broth use), the Kruskal-Wallis test identified significant effects for oyster mushroom aroma ($H = 12.92 > 5.991$) and oyster mushroom taste ($H = 16.381 > 5.991$). The remaining four attributes color, mirepoix aroma, umami taste, and texture (clarity) did not differ significantly across treatments in the dissolved state.

1. Oyster Mushroom Aroma (Dissolved Condition)

Oyster mushroom aroma showed the clearest treatment effect in the dissolved state. Tukey's post-hoc Q-test revealed that P1 (70:30; mean = 4.33) and P2 (60:40; mean = 4.20) did not differ significantly from each other ($Q_h < Q_t = 3.42$), but both differed significantly from P3 (50:50; mean = 3.07). This pattern indicates a threshold effect: the transition from 40% to 50% mirepoix proportion crosses a critical threshold at which the dilution of mushroom volatile aromatic compounds becomes clearly perceptible to panelists.

The dissolution process is key to understanding this pattern. When powder is dissolved in warm water, volatile flavor compounds are released into the headspace and become available for retronasal olfaction. The oyster mushroom aroma is primarily carried by water-soluble volatile compounds including 1-octen-3-ol and its derivatives. At higher mirepoix proportions, the celery and onion volatile compounds (terpenoids, organosulfides) compete with mushroom volatiles in the headspace, suppressing the perceived intensity of mushroom-specific aroma. This competition becomes detectable only in the dissolved state because volatile release is much more efficient in aqueous solution than from dry powder.

2. Oyster Mushroom Taste (Dissolved Condition)

Oyster mushroom taste in the dissolved state showed the largest H-value (16.381) of any attribute tested, indicating the strongest treatment effect. Tukey's post-hoc analysis revealed a clear distinction: P1 (70:30; mean = 4.67) scored significantly higher than both P2 (60:40; mean = 3.20) and P3 (50:50; mean = 3.07), while P2 and P3 did not differ significantly from each other.

The amplification of mushroom taste differences under dissolved conditions compared to the dry condition where P1 and P2 were not significantly different is explained by the enhanced bioavailability of flavor-active compounds in aqueous solution. Dissolution facilitates extraction and release of free amino acids and nucleotides from the powder matrix, making them available to taste receptors on the tongue. The concentration of free glutamate in solution is therefore directly proportional to the mushroom content of the formulation, producing a quantitatively measurable difference that is perceptible to panelists. The jump in discriminating power (from non-significant P1 vs P2 in dry to significant P1 vs P2 in dissolved) confirms that aqueous dissolution dramatically enhances the sensitivity of sensory evaluation for flavor-active compound differences between treatments.

3. Non-Significant Attributes in Dissolved Condition

The absence of significant effects for color, mirepoix aroma, umami taste, and texture (clarity) in the dissolved state warrants discussion. For color, dissolution at the standardized concentration (0.25 g/25 mL) produces a dilute solution in which color differences between treatments are diminished relative to the dry state. Mirepoix aroma not reaching significance may reflect the balance between treatment differences and individual variability in olfactory sensitivity among panelists. The non-significance of umami taste in the dissolved state is interesting given that it was significant in the dry state: this may reflect the context-dependence of umami perception, where a dilute aqueous solution may not concentrate dissolved glutamate sufficiently to produce perceptible differences at the 0.25 g/25 mL evaluation concentration. Texture (clarity) uniformly showed low scores across treatments, indicating that all formulations produced turbid solutions with residual particulate matter a characteristic of coarsely milled natural ingredient powders without added clarifying agents or hydrocolloids.

Physical Properties

1. Acidity (pH)

One-way ANOVA revealed a highly significant effect of oyster mushroom-to-mirepoix ratio on pH values ($F_{count} = 174.889 > F_{table} = 4.066$; df treatment = 3, df error = 8; $\alpha = 0.05$). Duncan's Multiple Range Test assigned a distinct letter notation to each treatment, confirming that all four treatments differed significantly from one another in pH (Table 3).

Figure 7. Dissolved Powder pH Testing

Source : Personal Documentation

Table 3. Mean pH values, standard deviations, and DMRT notation for each treatment (n = 3 replications per treatment)

Treatment	Mushroom:Mirepoix	Mean pH (± SD)	DMRT Notation (5%)
Control	100:0	5.483 ± 0.006	a
P1	70:30	5.353 ± 0.006	b
P3	50:50	5.350 ± 0.015	c
P2	60:40	5.307 ± 0.006	d

Different superscript letters indicate significantly different means at $\alpha = 0.05$ (Duncan's DMRT). Values ordered by descending pH.

The pH values of all treatments fall within the range of 5.3–5.5, which is mildly acidic. This range is within the normal pH range for reconstituted natural seasoning products (SNI 2004 specifies pH 4.6–6.5 as the standard for broth-type products; Arinda et al., 2023), confirming that all formulations are physically stable and appropriate for use as food seasoning. The significant differences between treatments reflect the systematic influence of mirepoix composition on product acidity: as mirepoix proportion increases, pH decreases. This trend is consistent with the contribution of organic acids naturally present in the mirepoix components. Celery contains malic acid and other aliphatic organic acids; carrot contains small quantities of citric and succinic acids; and onion contains pyruvic acid generated from alliinase activity. The cumulative effect of increasing mirepoix proportion is a gradual reduction in pH as these organic acids are incorporated into the powder matrix in greater total quantity.

The pH also has implications for the umami flavor profile. Amino acids including glutamic acid exist in different ionic forms depending on pH, and the intensity of umami perception is influenced by the ionization state of glutamate. At pH values between 5.3 and 5.5 (the range observed in this study), the majority of glutamate is in the monosodium glutamate form that is most efficiently recognized by umami taste receptors (mGluR4 and T1R1/T1R3 receptor complexes), with receptor stimulation decreasing significantly at pH below 4.5 or above 7.5 (Ueda et al., 2023). This confirms that all tested formulations maintain a pH range compatible with effective umami receptor stimulation, supporting their function as flavor enhancers.

The Control treatment's highest pH (5.483) is consistent with the chemical characteristics of pure dried oyster mushroom powder, which is mildly acidic due to its organic acid content but lacks the additional acidic contribution of vegetable components. The 70:30 treatment (P1) produced the pH closest to neutral among all mirepoix-containing formulations (5.353), which from a culinary application perspective means it will produce the least perceivable sourness or astringency in the final dish, a desirable characteristic for a general-purpose seasoning powder.

Total Dissolved Solids (°Brix)

ANOVA revealed no significant effect of oyster mushroom-to-mirepoix ratio on total dissolved solids, measured as °Brix ($F_{count} = 1.222 < F_{table} = 4.066$; $\alpha = 0.05$). Mean °Brix values ranged from 1.33 (Control and P1) to 2.00 (P3), with overlapping variation across treatments.

Figure 8. Dissolved Powder Brix Testing

Source : Personal Documentation

Table 4. Mean °Brix values for each treatment (n = 3 replications)

Treatment	Mushroom:Mirepoix	Mean °Brix (± SD)	ANOVA Result
Control	100:0	1.33 ± 0.00	Not significant
P1	70:30	1.33 ± 0.00	Not significant
P2	60:40	1.67 ± 0.29	Not significant
P3	50:50	2.00 ± 0.00	Not significant

Fcount = 1.222 < Ftable = 4.066 (df treatment = 3, df error = 8, $\alpha = 0.05$). No post-hoc test applied.

The absence of a significant °Brix difference across treatments indicates that varying the mushroom-to-mirepoix ratio within the tested range (50:50 to 100:0) does not produce detectably different concentrations of total soluble solids in the dissolved product at the standardized preparation concentration (4 g/400 mL). This finding may initially seem counterintuitive, since mirepoix components particularly carrot and onion contain substantial natural sugars (glucose, fructose, sucrose) that should theoretically contribute to °Brix. However, the non-significance likely reflects the relatively small absolute differences in total soluble solid content between treatments when diluted to the evaluation concentration, the measurement imprecision of the refractometric method at these low concentrations, and the fact that the dominant °Brix contributor in all treatments is the salt component (20% by weight), which masks the smaller variation attributable to the mushroom-to-mirepoix ratio.

From a product development perspective, the non-significant °Brix result is practically useful: it means that varying the mushroom-to-mirepoix ratio within the 50:50 to 70:30 range does not substantially alter the total soluble solid output of the powder upon dissolution, implying that formulation changes can be made on the basis of sensory and pH optimization without concern that they will change the effective “concentration” of the dissolved product perceptible to refractometric measurement.

CONCLUSION

This study systematically demonstrated the influence of oyster mushroom-to-mirepoix ratio on the physical properties and sensory quality of mushroom seasoning powder across four formulation levels (Control 100:0, P1 70:30, P2 60:40, P3 50:50). The principal findings are as follows. First, the ratio significantly affected acidity (pH), with ANOVA confirming a highly significant treatment effect ($F_{count} = 174.889$, $p < 0.05$) and Duncan's DMRT establishing that all four treatments were mutually distinct; total dissolved solids (°Brix) were not significantly affected. Second, for sensory quality under dry conditions, significant Kruskal-Wallis effects were identified for color, umami taste, and oyster mushroom taste, with the 70:30 ratio consistently scoring highest across these attributes. Third, under dissolved conditions simulating real-world broth application significant effects were found for oyster mushroom aroma ($H = 12.92$) and oyster mushroom taste ($H = 16.381$), with Tukey's post-hoc analysis confirming that the 70:30 treatment achieved significantly higher scores than the 50:50 treatment on both attributes.

Based on the totality of physical and sensory evidence, the 70:30 oyster mushroom-to-mirepoix formulation is identified as the optimal formulation. It produced the most visually appealing pale cream-yellow color, the strongest oyster mushroom aroma and taste under both dry and dissolved conditions, strong umami intensity in dry evaluation, fine powder texture, and the pH closest to neutral among all mirepoix-containing treatments all properties desirable in a general-purpose natural seasoning powder intended to replace synthetic MSG.

Future research directions recommended on the basis of these findings include: (1) proximate composition analysis to confirm protein, amino acid, and free glutamate content of each formulation; (2) shelf-life stability testing under varied packaging (glass, foil, polyethylene) and storage conditions (temperature, humidity) to assess oxidative and microbiological stability; (3) larger-scale consumer preference testing with diverse demographic segments to validate market acceptance; and (4) investigation of mushroom seasoning powder as a functional food ingredient, examining bioactive compound retention (ergosterol, β-glucans) across the tested formulation ratios.

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REFERENCES

Amaliah, R., Wahyudi, R., & Sari, D.P. (2024). Natural umami sources as alternatives to synthetic flavor enhancers: A review of recent developments. Food Chemistry Advances, 3, 100453.

Arinda, F., Setyaningsih, I., & Jannah, M. (2023). Physical and chemical characteristics of natural broth powder from marine by-products. Indonesian Journal of Food Technology, 12(1), 45–58.

Dwi Anissa, P., Hartini, S., & Kusuma, D. (2021). Nutritional composition and bioactive compounds of edible mushrooms: A review. Indonesian Journal of Food Science, 10(2), 34–47.

Feranika, A., & Dewi, R. N. (2023). Feasibility analysis of oyster mushroom-based seasoning powder industry: Technical and financial perspectives. Agroindustri Journal, 13(1), 12–24.

Gisslen, W. (2007). Professional cooking (7th ed.). John Wiley & Sons.

Gozali, T. (2020). Continental culinary techniques: From classical to modern applications. Culinary Arts Press.

Kadaryati, S., & Yuni Afriani, Y. (2022). Formulation and sensory evaluation of seasoning powder based on oyster mushroom (Pleurotus ostreatus). Indonesian Food and Nutrition Progress, 19(1), 22–31.

Kadaryati, S., Afriani, Y., & Nugroho, A. (2021). Effect of salt and sugar addition on sensory acceptability of oyster mushroom-based seasoning powder. Jurnal Teknologi Pangan, 12(2), 89–99.

Khalimatur Rahmah, N., & Kholifatuddin Sya, A. (2023). Potential of oyster mushroom as natural umami enhancer and its application in functional food development. Journal of Food Bioactives, 8, 45–57.

Kuntari, S., & Fitriani, A. (2021). Post-harvest management of oyster mushrooms in West Java: Challenges and economic opportunities. Agribusiness Journal, 8(2), 77–89.

Maulidia, R., & Pujilestari, T. (2025). Effect of mushroom proportion on color and texture of mushroom-based seasoning powder. Food Science and Technology Letters, 4(1), 12–19.

Pinandita, R., Rahayu, W., & Hartono, S. (2024). Drying method effects on physical and sensory properties of vegetable seasoning powder. Food Technology and Biotechnology, 62(1), 55–63.

Prasetyaningsih, A., Devi, R., & Santoso, M. (2018). Optimization of drying temperature for oyster mushroom powder: Effects on proximate composition and sensory quality. Agritech, 38(3), 245–253.

Purnomo, A. S., Setiawan, B., & Rahmawati, F. (2022). Community empowerment through oyster mushroom seasoning powder production training in Desa Boto, Klaten. Journal of Community Service, 6(1), 1–10.

Rosmiah, R., Iin Siti Aminah, I.S., & Dewi, P. (2020). Volatile compound formation during drying of Pleurotus ostreatus: Implications for flavor development. Journal of Agricultural and Food Chemistry (Indonesia), 5(2), 88–99.

Tagkouli, D., Bekiaris, G., Pantazi, S., Anastasopoulou, E., Feggos, G., Koutrotsios, G., Kalogeropoulos, N., Zervakis, G. I., & Tsigarida, E. (2020). Free amino acids and umami taste-contributing compounds in Pleurotus spp. mushrooms. LWT – Food Science and Technology, 127, 109377. https://doi.org/10.1016/j.lwt.2020.109377

Ueda, T., Shimamoto, K., & Tanaka, T. (2023). pH effects on umami receptor activation and glutamate taste intensity. Flavour and Fragrance Journal, 38(2), 102–114.

Wahyuni, S., Handayani, T., & Krisanti, E. (2021). Refractometric measurement of seasoning powder solubility: Methodological considerations. Indonesian Journal of Applied Chemistry, 23(1), 55–62.