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NUTRITIONAL PROFILE, ANTIOXIDANT POTENTIAL, FATTY ACID COMPOSITION, QUALITY CHARACTERISTICS AND SENSORY ATTRIBUTES OF MAYONNAISE FROM *PERSEA AMERICANA* AND *PYRUS COMMUNIS* OIL BLENDS

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Abstract

This study evaluated the nutritional, physicochemical, antioxidant, microbial, and sensory properties of mayonnaise produced from blends of avocado (Persea americana) and pear (Pyrus communis) oils. Pear oil was extracted using a cold-press method and blended with commercially sourced avocado oil at ratios of 80:20 (Sample A), 70:30 (Sample B), and 60:40 (Sample C), while commercial mayonnaise served as the control (Sample D). The oil blends were analyzed for physicochemical properties, proximate composition, antioxidant activity, and fatty acid profile, while the resulting mayonnaise samples were assessed for physicochemical characteristics, proximate composition, microbial quality, and sensory attributes. Blending significantly ($p < 0.05$) improved key quality parameters, with mayonnaise samples showing pH values of 3.90-4.17, density of 0.89-0.92 g/cm³, emulsion stability of 95.50-99.82%, iodine values of 70.87-102.66 g/100 g, and peroxide values of 2.60-3.67 meq O_2/kg. Proximate composition also increased significantly, with moisture (31.16-39.42%), ash (1.11-1.54%), protein (1.62-2.66%), fat (31.03-39.01%), crude fiber (0.67-0.72%), and carbohydrate (17.78-33.67%), while energy values ranged from 421.69 to 428.65 kcal. Microbial loads were within acceptable safety limits for ready-to-eat foods. Sensory evaluation indicated that all samples, except the 70:30 blend, were generally acceptable and comparable to the control. Overall, incorporation of pear oil at 20-40% substitution levels produced nutritionally enhanced and acceptable mayonnaise, highlighting its potential for value addition and reduction of postharvest losses through improved utilization.

1- Introduction

According to the Official Mexican Standard NMX-F-341-S-1979, a mayonnaise type-dressing is defined as a food product used to flavor other foods, requiring not less than 50% of mayonnaise or equivalent edible vegetable oils and egg yolk (Urooj et al., 2026a). Although mayonnaise traditionally contains 70-80% oil where the oil component contributes greatly to the final product's sensory properties, conventional

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processing and high saturated lipid contents present technological and health-related challenges (Iqbal et al., 2026; Arif et al., 2026a). Consequently, there is a current market trend toward lower oil contents, functional ingredient addition, and fat replacement to produce healthier, low fat dressings that align with consumer demand (Shabbir et al., 2026; Tavakoli et al., 2021).

Incorporating monounsaturated fatty acid-rich sources, such as avocado oil with high oleic acid and antioxidant content, significantly enhances nutritional and oxidative quality (Arif et al., 2026b; Flores et al., 2019;). Furthermore, alternative processing methods like ultrasound cavitation facilitate stable emulsion formation while effectively addressing the lipid oxidation and pigment degradation limitations of conventional thermal treatments (Guzmán-Gerónimo et al., 2022). The increasing demand for functional foods with enhanced nutritional and health promoting properties has stimulated interest in plant-derived oils rich in bioactive compounds. Tropical fruits such as avocado (*Perseaamericana*) and pear (*Pyrus communis*) have gained attention as promising sources of high quality lipids and natural antioxidants suitable for food formulation (Butt et al., 2026).

Avocado (*Perseaamericana*), a fruit widely cultivated in tropical and subtropical regions, is recognized for its exceptional nutritional composition and lipid profile. It is rich in monounsaturated fatty acids (MUFA), particularly oleic acid, as well as vitamins, minerals, and bioactive compounds such as carotenoids and phytosterols. These components contribute to its reported cardioprotective and antioxidant effects (Ford *et al.*, 2023). Recent studies further emphasize that avocado pulp differs significantly from most fruits due to its high lipid content and functional phytochemicals, making it a valuable ingredient in the development of functional foods (Fazal et al., 2026; Arif et al., 2026). Avocado oil has been classified as a functional edible oil due to its favorable fatty acid composition and nutritional benefits, which are influenced by factors such as cultivar, maturity, and processing techniques (Marra*et al.*, 2024).

Pear (*Pyrus communis*), an indigenous local name nashpati, fruit widely consumed in West and Central Africa, represents an underutilized but nutritionally significant lipid source. The fruit pulp contains substantial quantities of oil (approximately 27-35%), along with proteins, dietary fiber, and essential micronutrients, making it a valuable component of traditional diets. Previous studies have highlighted its potential for edible oil production and its role in improving food security and nutrition in developing regions (Nwosuagwu*et al.*, 2020; Onuegbu*et al.*, 2021).

The extraction of oils from fruit mesocarps can be achieved using conventional and modern techniques, including solvent extraction, mechanical pressing, and green processing technologies (Naqvi et al., 2025). These methods influence both the yield and quality of the extracted oils, thereby affecting their suitability for food applications (Alenyorege *et al.*, 2020; Chaudhry et al., 2026). The incorporation of such oils into widely consumed products offers a strategic approach to improving dietary lipid quality and enhancing the nutritional value of processed foods.

Mayonnaise, a semi-solid oil inwater emulsion traditionally formulated from vegetable oil, egg yolk, and an acidifying agent, serves as an ideal vehicle for the incorporation of functional oils. It typically contains not less than 65% oil and relies on emulsifiers to stabilize dispersed oil droplets within an aqueous phase (McClements, 2020). Recent advancements in food science have focused on reformulating mayonnaise using alternative plant oils to improve its lipid profile, oxidative stability, and overall health benefits (Gharibzahedi and Smith, 2021; Arif et al., 2026c).

Therefore, the utilization of blended oils from avocado (*Persea americana*) and pear (*Pyrus communis*) in mayonnaise production presents a promising strategy for developing nutritionally enhanced spreads with improved lipid composition and antioxidant capacity. This study, therefore, evaluated the nutritional components, lipid profile, antioxidant potential and sensory attributes of mayonnaise formulated from these oil blends.

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2- Materials and Methods

2.1 Procurement of raw materials

The raw materials used in this study were avocado (*Persea americana*), pear (*Pyrus communis*) fruits, commercial mayonnaise, fresh eggs, lemon, sugar, and salt. All materials used in the study were procured from local markets in Faisalabad.The raw materials were carefully transported under hygienic conditions to the Food Science and Technology Analytical Laboratory for subsequent processing and analysis. All chemical reagents utilized for the analyses were of analytical grade and were obtained from standard laboratory suppliers.

2.2 Oil extraction procedure

Fresh pear (*Pyrus communis*) fruits were thoroughly washed with clean water to remove adhering dirt and extraneous materials, and subsequently air dried to eliminate surface moisture. The fruits were then held at ambient temperature (28 °C) for 72 h to allow for softening and partial enzymatic browning of the mesocarp. Thereafter, the seeds were manually separated from the edible pulp. The mesocarp was mechanically mashed into a uniform paste using a sterile tray and fork. The resulting paste was subjected to mild thermal treatment at a temperature not exceeding 60 °C for 40 min, with intermittent stirring, until visible oil separation occurred. The heated paste was then transferred into a clean muslin cloth and manually pressed to extract the crude oil. The extracted oil was subsequently filtered through a Whatman filter paper to remove residual solid particles. The clarified oil was collected in clean, dry, airtight containers and stored under cool, dry conditions prior to further analysis.

(a) Avocado (*Persea americana*)



(b) Pear (*Pyrus communis*)



Figure 1: Pictorial representation of (a) Avocado (*Persea americana*) oil and (b) pear (*Pyrus communis*)

2.3 Oil blend formulation

Avocado (*Persea americana*) oil and pear (*Pyrus communis*) pulp oil were blended in predetermined ratios of 80:20, 70:30, and 60:40, respectively. The blending was carried out under ambient conditions to obtain homogeneous oil mixtures for subsequent analyses and product formulation

Table 1: Formulation of Avocado and Pear oil blends

Samples	Avocado Oil (*Persea americana*) (%)	Pear Oil (*Pyrus communis*) (%)	Blend Ratio (v/v)
A	80	20	80:20
B	70	30	70:30
C	60	40	60:40
D (Control)	0	0	0

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

2.4 Mayonnaise production

Mayonnaise was produced following the method of Rajasekaran *et al.* (2024) with slight modifications. The formulation ingredients egg yolk (18 g), lemon juice (5 g), sugar (2 g), and salt (1 g) were initially combined and homogenized using a laboratory blender. Subsequently, the oil (45 g) was gradually incorporated in a thin, continuous stream while blending at low to medium speed to ensure proper emulsification and prevent phase separation. The resulting emulsion was carefully transferred into clean bottles and sealed with airtight caps. The packaged samples were then sterilized at 121 °C for 15 min, followed by rapid cooling using chilled water. The mayonnaise samples were stored under refrigerated conditions (4-10 °C) prior to further analysis.

2.5 Determination of proximate composition

Proximate composition of mayonnaise samples, avocado (*Persea americana*) and pear (*Pyrus communis*) oils were determined in accordance with (AOAC, 2016). Moisture content was determined by oven drying a known weight of sample to a constant weight at 105 °C (AOAC 925.09). Ash content was evaluated by incinerating the pre-dried samples in a muffle furnace at 550 °C until a constant weight and carbon-free residue were obtained (AOAC 923.03). Crude protein was quantified using the micro-Kjeldahl method (AOAC 979.07), involving acid digestion, distillation, and titration, wherein total nitrogen content was converted to crude protein using a conversion factor of 6.25. Crude fat was determined by Soxhlet extraction (AOAC 920.85) using analytical grade *n*-hexane as the solvent, followed by gravimetric quantification of the extracted lipid residue. Crude fiber was measured by sequential dilute acid and alkaline digestion followed by drying, weighing, and ashing of the insoluble residue. Total carbohydrate content was calculated by difference using the equation:

Total Carbohydrates (%) = 100 - (%Moisture + %Ash + %Crude Protein + %Crude Fat + %Crude Fiber).

2.6 Density determination

The density of formulated mayonnaise as well as avocado (*Persea americana*) and pear (*Pyrus communis*) oils were measured gravimetrically using a calibrated 25 mL glass pycnometer at 25 °C according to the method outlined by Adepoju et al. (2022). The empty, clean, and thoroughly dried pycnometer was weighed (M_0), filled with oil or mayonnaise sample avoiding air bubble formation, brought to the target temperature (25 °C), and re weighed (M_1).

The density (ρ) in g/cm^3 was calculated using the following equation:

$$\rho = \frac{M1 - M0}{V}$$

where V represents the calibrated volume of the pycnometer.

2.7 Determination of fatty acid composition

Fatty acid composition of avocado and pear oils was determined via gas chromatography coupled with a flame ionization detector (GC-FID), following Christopoulou et al. (2021). 50 mg of each lipid sample was transesterified using 2 mL of methanolic potassium hydroxide and 2 mL of *n*-hexane. The mixture was vortexed for 2 minutes and allowed to stand to facilitate phase separation. The upper organic layer containing the fatty acid methyl esters (FAMEs) was collected, dried over anhydrous sodium sulfate (Na_2SO_4), and filtered through a 0.22 µm PTFE membrane filter. An aliquot (1 µL) was injected into a gas chromatograph fitted with a capillary column (HP-88, 100 m × 0.25 mm ID, 0.20 µm film thickness). Helium was utilized as the carrier gas at a flow rate of 1.0 mL/min. The injector and detector temperatures were maintained at 250 °C and 260 °C, respectively. Fatty acids were identified by comparing their retention times with a certified 37-component FAME standard mix, and individual fatty acids were expressed as relative % of total fatty acids.

2.8 Determination of antioxidant activity

Radical scavenging activity of the oils was evaluated following the protocol described by Al-Okbi et al. (2026). An aliquot (0.1 mL) of diluted oil sample (dissolved in methanol) was mixed with

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3.9 mL of a freshly prepared 0.1 mM 2,2-diphenyl-1-picrylhydrazyl (DPPH) solution. The reaction mixture was incubated in the dark at ambient temperature (25 °C) for 30 minutes. The decrease in absorbance was measured spectrophotometrically at 517 nm against a blank. Radical scavenging activity was calculated using the following equation:

$$Inhibition\ (\%) = \frac{(Acontrol - Asample)}{Acontrol} \times 100$$

Results were expressed as IC_{50} values or Trolox equivalents (µmol TE/g).

2.9 Determination of lipid quality indices

The lipid quality indices of avocado and pear oils were evaluated using standard AOAC International (2016) titrimetric methods: free fatty acids (AOAC 940.28; expressed as % oleic acid), peroxide value (AOAC 965.33; iodometric titration, meq O_2/kg), iodine value (AOAC 993.20; Wijs method, g I_2/100 g), saponification value (AOAC 920.160; ethanolic KOH titration, mg KOH/g), and unsaponifiable matter (AOAC 933.08; gravimetric extraction).

2.10 Determination of Vitamin E (Tocopherol) content

Total tocopherol content of the oil samples was determined via HPLC-FLD following Reboul et al. (2016). Filtered sample extracts (0.22 µm) in n-hexane were resolved on a normal-phase silica column using an isocratic mobile phase of n-hexane/2-propanol (99:1, v/v) at 1.0 mL/min with fluorescence detection (λex = 290 nm, λem = 330 nm), and quantified against external standards (mg/kg).

2.11 Determination of pH

pH of mayonnaise samples (10 g homogenized in 90 mL deionized water) was measured using a pre-calibrated digital pH meter at 25 ± 1 °C (Odep et al., 2024).

2.12 Determination of sensory evaluation

Sensory profiling of the control and experimental avocado/African pear oil mayonnaise formulations was conducted using a 9-point hedonic scale (where 1 = dislike extremely and 9 = like extremely) in accordance with the protocol described by (Urooj and Asif, 2026d) and Odep et al. (2024). A panel of 20 semi-trained assessors evaluated the samples for sensory attributes including appearance, color, aroma, mouthfeel, taste, and overall acceptability. Approximately 15 g of each coded mayonnaise sample was served at room temperature (25 °C) in clear, odor free plastic cups identified with random 3-digit codes, accompanied by unsalted crackers and potable water for palate cleansing between evaluations.

2.13 Determination of microbial load

Microbial enumeration was performed using the standard serial dilution and pour plate method (Udo & Ojimelukwe, 2024). Homogenized samples in sterile 0.1% (w/v) peptone water (10^{-1} to 10^{-6}) were plated on Plate Count Agar (37 °C, 48 h) for total viable count, acidified Potato Dextrose Agar (25 °C, 3-5 days) for yeasts and molds, and Violet Red Bile Agar (37 °C, 24 h) for coliforms, with results reported as $\log_{10}$ CFU/g.

2. 14 Statistical analysis

All the data were subjected to statistical analysis using Analysis of Variance (ANOVA). The means were then separated with the use of Duncan New Multiple Range Test using the Statistical Package for the Social Sciences (SPSS) 23.0 software.

3- Results and Discussions

3.1 Proximate composition of oils

Proximate composition of oils is presented in Table 2. Results showed that moisture, protein, fat, and crude fiber contents were significantly higher ($p < 0.05$) in pear oil, with values of 0.28%, 0.89%, 97.01%, and 0.77%, respectively. Conversely, ash and carbohydrate contents were significantly higher in avocado oil, recorded as 0.62% and 1.10%, respectively. These nutrients play essential roles in human health: proteins contribute to the formation of antibodies, repair of tissues, and regulation of physiological functions, while fats, predominantly unsaturated in these oils, provide high energy, act as insulators, and support absorption of fat soluble vitamins. However, excessive intake of certain fats may lead

Frontier in Medical & Health Research

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to obesity, hypertension, and arteriosclerosis. Despite variations in composition, both oils share similar constituents and serve as valuable dietary sources. Moderate consumption of pear oil may support cardiovascular health, proper muscle contraction, nervous system function, blood clotting, and fluid balance, partly due to its calcium content. The protein content of both oils could help mitigate protein deficiency, while the fiber content enhances oil quality and digestibility. Carbohydrate levels, although moderate, provide an additional source of calories. Overall, the nutrient composition of these oils aligns closely with WHO standards, indicating their potential as nutritious food ingredients and functional components in dietary formulations (Ngozi-Olehi, 2012).

Table 2: Proximate composition (%) of oil samples

Parameters	Avocado oil	Pear oil
Moisture	0.19 ± 0.17^{b}	0.28 ± 0.31^{a}
Ash	0.62 ± 0.05^{a}	0.54 ± 0.06^{b}
Protein	0.79 ± 0.05^{b}	0.89 ± 0.06^{a}
Fat	96.73 ± 0.05^{b}	97.01 ± 0.06^{a}
Crude fiber	0.59 ± 0.05^{b}	0.77 ± 0.06^{a}
Carbohydrate	1.10 ± 0.05^{a}	0.51 ± 0.06^{b}

3.2 Physicochemical properties of oils

The physicochemical properties of the avocado (*Persea americana*) and pear (*Pyrus communis*) oils, as influenced by blending ratios, are summarized in Table 3. Free fatty acid (FFA) content was significantly higher in pear oil (0.95%) than in avocado oil (0.37%) ($p < 0.05$), reflecting greater hydrolytic activity and potential susceptibility to rancidity. The lower FFA in avocado oil aligns with Codex Alimentarius recommendations (0.05–0.5%) and indicates better suitability for direct consumption and reduced refining requirements, whereas pear oil exceeded this limit, suggesting a need for further processing (Al-Bachir, 2015; Onwuzuruike *et al.*, 2020). Saponification values, indicative of mean triglyceride molecular weight, were higher in avocado oil (231.62 mg KOH/g) than in pear oil (126.35 mg KOH/g), suggesting potential for harder soap production. Iodine values were moderately higher in pear oil (42.89 g/100 g) compared to avocado oil (40.31 g/100 g), reflecting higher unsaturation, which is beneficial for health but increases susceptibility to oxidation (Asuquo *et al.*, 2012; Sadoudi and Ali-Ahmed, 2017). Pear oil also showed higher unsaponifiable matter (47.66%) compared to avocado oil (15.32%), indicating richness in sterols, phospholipids, and other bioactive compounds useful in pharmaceuticals and food applications. Peroxide value (PV), a measure of primary oxidation, was higher in pear oil (9.00 meq O_2/kg) than avocado oil (8.71 meq O_2/kg), though both were below the Codex maximum limit of 10 meq O_2/kg (Atinafu and Bedemo, 2011). Tocopherol (vitamin E) content was significantly higher in avocado oil (30.67 mg/kg) than in pear oil (19.40 mg/kg), enhancing oxidative stability and nutritional value (Rohit and Kanjan, 2018). The lower vitamin E in pear oil may be attributed to processing steps such as refining and deodorization. Specific gravity was higher in African pear oil (1.10) than avocado oil (0.95), showing greater density. Overall, these results suggest that blending avocado and pear oils could optimize physicochemical and nutritional qualities, improving fatty acid profile, oxidative stability, and bioactive compound content for food applications (Akriti *et al.*, 2018).

Table 3: Physicochemical properties of the oil samples

Parameters	Avocado oil	Pear oil
Free fatty acid (%)	0.37 ± 0.17^{b}	0.95 ± 0.31^{a}

Frontier in Medical & Health Research

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Saponification value (mg KOH/g)	231.62 ± 0.05[a]	126.35 ± 0.06[b]
Iodine value (g/100 g)	40.31 ± 0.05[b]	42.89 ± 0.06[a]
Unsaponifiable matter (%)	15.32 ± 0.05[b]	47.66 ± 0.06[a]
Peroxide value (meq O_2/kg)	8.71 ± 0.05[b]	9.00 ± 0.06[a]
Tocopherol (mg/kg)	30.67 ± 0.05[a]	19.40 ± 0.06[b]
Specific gravity	0.95 ± 0.05[b]	1.10 ± 0.06[a]

3.3 Antioxidant activities of Oils

The antioxidant activities of oils are presented in Figure 2. Oxidative degradation in edible oils involves complex chain reactions including hydrolysis, oxidation, and polymerization that can lead to rancidity and reduced nutritional quality (Johnson and Decker, 2015). In this study, radical scavenging activities were assessed using the DPPH and FRAP assays, targeting reactive species such as hydroxyl radicals, superoxide radicals, and hydrogen peroxide. These methods provide complementary insights into the oils' abilities to neutralize free radicals and prevent oxidative deterioration. Results showed variation in antioxidant capacity between the oils. Pear oil exhibited the highest total antioxidant activity in the DPPH assay, while avocado oil showed the lowest activity in the FRAP assay. Differences in antioxidant potential may be attributed to variations in processing techniques and the differential retention of bioactive compounds. Refining steps, including bleaching and alkali treatment, can absorb some antioxidant components, while high-temperature deodorization can degrade sensitive compounds such as tocopherols (Ergönül and Köseoğlu, 2014; Kreps *et al.*, 2015). These findings highlighted the importance of optimizing refining conditions to preserve antioxidant constituents in edible oils and maintain their functional and nutritional qualities.

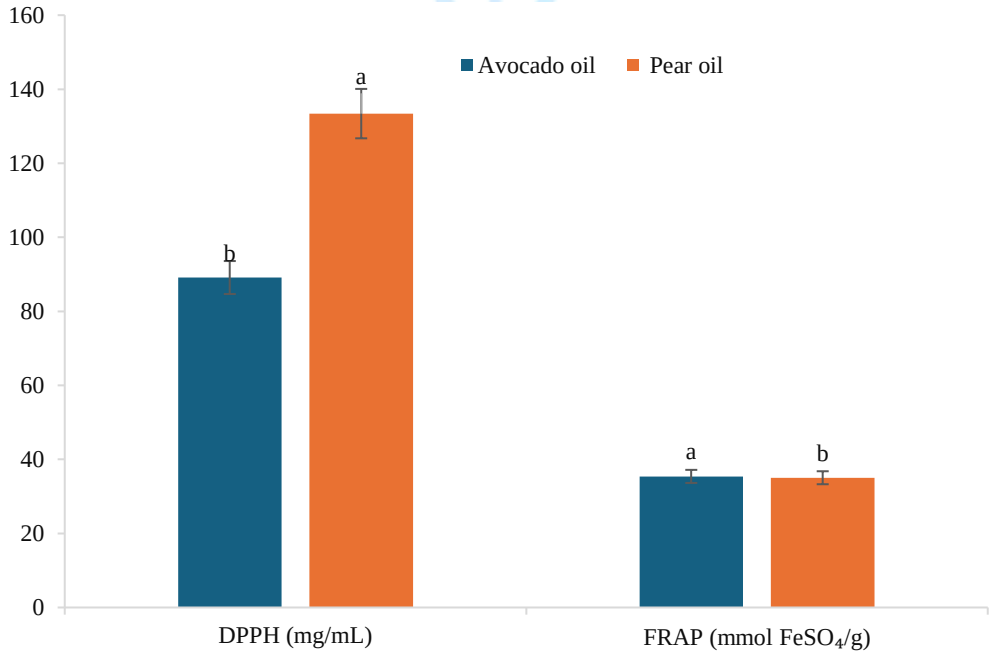


Figure 2: Antioxidant activities of avocado and pear oils as determined by DPPH and FRAP assays.

3.4 Fatty acids profile of oils

As presented in Table 4, the fatty acid profiles of both avocado oil and pear oil are characterized by significant proportions of unsaturated fatty acids (oleic and linoleic acids) alongside saturated fatty acids (palmitic and stearic acids). Pear oil showed

Frontier in Medical & Health Research

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significantly higher ($p < 0.05$) levels across all quantified fatty acids compared to avocado oil, with linoleic acid (31.79%) and oleic acid (28.47%) being the major constituents. In avocado oil, oleic acid (24.44%) and linoleic acid (23.88%) also constituted the predominant fractions. The substantial presence of oleic acid, a monounsaturated fatty acid, contributes to improved oxidative stability and nutritional value, making these oils viable candidates for cooking and food formulation (Aras & Rohman, 2025; Aras et al., 2026). Furthermore, both oils contained appreciable levels of linoleic acid an essential polyunsaturated fatty acid associated with cardioprotective benefits and reduced cardiovascular risk. The saturated fatty acid fractions, comprising palmitic acid (6.95% in avocado; 8.82% in pear) and stearic acid (10.99% in avocado; 13.96% in pear), provide structural functionality without dominating the lipid profile. The outcomes showed that the balanced ratio of monounsaturated to polyunsaturated fatty acids indicates that both avocado and pear oils compare favorably with conventional vegetable oils, supporting their potential to diversify edible oil sources while providing distinct nutritional benefits (Nwachukwu et al., 2024)

Table 4: Fatty acids composition (%) of oils

Parameter	Avocado oil	Pear oil
Palmitic	6.95 ± 0.05[b]	8.82 ± 0.06[a]
Stearic	10.99 ± 0.06[b]	13.96 ± 0.06[a]
Oleic	24.44 ± 0.05[b]	28.47 ± 0.06[a]
Linoleic	23.88 ± 0.05[b]	31.79 ± 0.06[a]

3.5 Proximate composition and energy value of mayonnaise

The proximate composition of mayonnaise as shown in Table 5. Blending significantly ($p < 0.05$) influenced the proximate characteristics. Moisture content of the blended mayonnaise samples ranged from 31.16% to 39.42%, with lower values in most blended formulations compared with the control. Lower moisture in mayonnaise is associated with improved emulsion stability and extended shelf life, as increased water content can compromise texture and microbial resistance (Abirached *et al.*, 2025). Ash content, indicating total mineral content, varied from 1.11% to 1.54% across the samples, with higher values in blended formulations suggesting enhanced mineral availability compared with the control. Protein content ranged from 1.62% in the control to 2.66% in the sample containing 60% avocado and 40% pear oil, reflecting contributions from egg yolk which is critical for emulsification and stability in mayonnaise (Arshad *et al.*, 2025). Fat content, a major determinant of mouthfeel and energy density, ranged from 31.03% to 39.01%, with blended samples exhibiting moderately lower values than the control; this aligns with broader trends showing how formulation changes affect fat levels in emulsion products (Abirached *et al.*, 2025). Crude fiber levels were low (0.67–0.72%) across all samples, while carbohydrate content varied (17.78–33.67%), influenced by formulation differences similar to variations observed in other mayonnaise studies (Arshad *et al.*, 2025).

Energy values, calculated from protein, fat, and carbohydrate contents using standard Atwater factors, were highest in the control sample (428.65 kcal/mol), primarily due to its higher fat content. Fat contributed 9 kcal/g, whereas protein and carbohydrates contributed 4 kcal/g, consistent with accepted nutritional modeling for emulsified foods. These findings are consistent with contemporary profiling of mayonnaise, which report high lipid content as the major contributor to energy density in traditional formulations (Arshad *et al.*, 2025; Abirached *et al.*, 2025). The differences in proximate composition and energy value among the mayonnaise samples demonstrate that partial substitution with pear oil can modify nutritional profiles while maintaining the characteristic properties of semi-solid oil in water emulsions, offering opportunities to tailor nutrient and energy content in functional food development.

Frontier in Medical & Health Research

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Table 5: Proximate composition and energy value of mayonnaise

Parameters	A	B	C	D
Moisture	31.16 ± 0.21^{d}	33.92 ± 0.02^{c}	35.07 ± 0.03^{b}	39.42 ± 0.17^{a}
Ash	1.54 ± 0.01^{a}	1.43 ± 0.01^{b}	1.37 ± 0.01^{c}	1.11 ± 0.01^{d}
Protein	1.94 ± 0.05^{c}	2.21 ± 0.01^{b}	2.66 ± 0.01^{a}	1.62 ± 0.02^{d}
Fat	31.03 ± 0.03^{d}	34.07 ± 0.02^{c}	35.41 ± 0.01^{b}	39.01 ± 0.01^{a}
Crude fibre	0.67 ± 0.01^{a}	0.68 ± 0.01^{a}	0.70 ± 0.01^{a}	0.72 ± 0.01^{a}
Carbohydrate	33.67 ± 0.20^{a}	27.75 ± 0.06^{b}	24.80 ± 0.01^{c}	17.78 ± 0.71^{d}
Energy (Kcal/mol)	421.69 ± 0.74^{b}	426.39 ± 0.47^{ab}	428.53 ± 0.13^{a}	428.65 ± 2.64^{a}

3.6 Physicochemical properties of mayonnaise

The physicochemical properties of mayonnaise prepared from avocado (*Persea americana*) and pear (*Pyrus communis*) oil blends are presented in Table 6. The pH values of the samples ranged from 3.90 in the control (100% avocado oil) to 6 in the sample containing 60% avocado and 40% pear oil, with significant differences observed among the treatments ($p < 0.05$). The acidic pH of mayonnaise is critical for its structural stability and microbial safety, as it inhibits spoilage and pathogenic growth. The observed increase in pH with higher pear oil inclusion may be attributed to the naturally higher pH of pear oil, which elevates the overall pH of the emulsion. While the pH values in this study were slightly higher than those reported for flavoured mayonnaise (3.78–3.91) and mayonnaise from virgin coconut and soybean oil blends (3.70–3.72), however, they fell within the range reported for mayonnaise processed with varying egg yolk contents (4.05–4.07) (Aleksandrs *et al.*,2016; Gaikwad *et al.*, 2017; Belal *et al.*, 2019). Overall, all mayonnaise samples remained acidic, supporting microbial stability and shelf-life enhancement.

Iodine values of the mayonnaise samples ranged from 70.87 to 102.66 g/100 g, indicating the high degree of unsaturation in the blended oils. Oil blends exhibited higher iodine values (80.61–102.66 g/100 g) compared to the control (70.87 g/100 g), suggesting an increased proportion of unsaturated fatty acids after blending. Higher unsaturation is beneficial for human health, contributing to reduced low-density lipoproteins and improved membrane integrity, though it may increase susceptibility to oxidation at elevated temperatures (Sunmonu *et al.*, 2016 ;Sadoudi and Ali-Ahmed, 2017). Peroxide values, a measure of lipid oxidation and freshness, ranged from 2.60 meq O_2/kg in the control to 3.67 meq O_2/kg in the 60:40 oil blend, remaining below the recommended maximum limits and indicating that the mayonnaise samples retained oxidative stability (Atinafu and Bedemo, 2011; Yang *et al.*, 2016). These results demonstrated that blending avocado and African pear oils can enhance the unsaturation level and potential health benefits of mayonnaise without compromising its freshness or stability.

Table 6: Physicochemical properties of Mayonnaise

Parameters	A	B	C	D
pH	4.10 ± 0.01^{b}	4.14 ± 0.01^{ab}	4.17 ± 0.01^{a}	3.90 ± 0.01^{c}
Density (g/cm^3)	0.91 ± 0.01^{a}	0.90 ± 0.01^{a}	0.89 ± 0.01^{a}	0.92 ± 0.01^{a}
Emulsion stability (%)	95.50 ± 0.51^{a}	95.50 ± 0.51^{a}	99.82 ± 0.01^{a}	95.50 ± 0.51^{a}
Iodine value (g/100 g)	80.61 ± 0.01^{c}	93.36 ± 0.03^{b}	102.66 ± 0.01^{a}	70.87 ± 0.01^{d}
Peroxide value (meq O_2/kg)	2.81 ± 0.01^{bc}	3.04 ± 0.01^{b}	3.67 ± 0.03^{a}	2.60 ± 0.14^{c}

3.7 Microbiological quality of mayonnaise

The microbiological quality of mayonnaise as presented in Table 7. As with other ready to eat food products, mayonnaise is susceptible to microbial contamination, particularly if hygienic conditions during processing and handling are not

Frontier in Medical & Health Research

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strictly maintained. Therefore, evaluation of microbial load is essential to ensure product safety and quality. In this study, conventional microbiological techniques were employed to determine total heterotrophic bacterial count (THBC), coliform count, *Staphylococcus* spp., *Vibrio* spp., and fungal load. The results revealed significant differences ($p < 0.05$) among the samples. The highest THBC (2.4×10^3 CFU/g) was recorded in the mayonnaise sample containing 70% avocado oil and 30% pear oil, while no heterotrophic bacteria were detected in the control (commercial mayonnaise) (Omohimi *et al.*, 2019). Similarly, coliform counts were highest (8.3×10^3 CFU/g) in the 60:40 blend but were absent in the control sample. No fecal coliforms, *Salmonella*, or *Shigella* species were detected in any of the samples, indicating compliance with basic microbiological safety standards. Further analysis showed that *Staphylococcus* counts were highest (7.0×10^3 CFU/g) in the 80:20 blend, while *Vibrio* species (3.1×10^3 CFU/g) were detected only in the 70:30 formulations. Fungal counts followed a similar trend to coliforms, with the highest load (3.1×10^3 CFU/g) observed in the 60:40 blend, whereas no fungal growth was recorded in the control sample (Odep *et al.*, 2024). Despite these variations, all microbial counts remained below the maximum permissible limit of 1.0×10^4 CFU/g recommended by the International Commission on Microbiological Specifications for Foods (ICMSF), indicating that the products were microbiologically safe for consumption (Omohimi *et al.*, 2019). Nevertheless, the presence of detectable microbial populations, particularly fungi, highlights the need for continuous monitoring and further species-level identification to rule out toxigenic organisms such as *Aspergillus*, *Penicillium*, and *Fusarium* spp. Implementation of strict good manufacturing practices (GMP), improved packaging, and routine quality control measures is therefore essential to minimize contamination risks and ensure the long-term safety and stability of mayonnaise and other products produced from different oil blends (Udo and Ojimelukwe, 2024; Mirzanajaf-Zanjani *et al.*, 2025).

Table 7: Microbial load (CFU/g) determination of Mayonnaise

Parameters	A	B	C	D
THBC	$2.0 \times 10^{3\,c}$	$2.4 \times 10^{3\,a}$	$2.1 \times 10^{3\,b}$	NG
CC	8.0×10^{3b}	5.5×10^{3c}	8.3×10^{3a}	NG
TFC	NG	NG	NG	NG
SSC	NG	NG	NG	NG
SC	$7.0 \times 10^{3\,a}$	$4.7 \times 10^{3\,b}$	$2.4 \times 10^{3\,c}$	NG
VC	NG	$3.1 \times 10^{3\,a}$	NG	NG
FC	$2.9 \times 10^{3\,b}$	$1.5 \times 10^{3\,c}$	$3.1 \times 10^{3\,a}$	NG

THBC - Total heterotrophic bacteria count, CC - Coliform count, TFC – Total fecal coliform
SSC - Salmonella and Shigella count, SC – Staphylococcus count, VC – Vibrio count, FC – Fungal count, NG - No Detectable Growths

3.8 Sensory properties of mayonnaise

The mean sensory scores for mayonnaise samples produced from avocado and pear oil blends are presented in Table 8. Sensory attributes evaluated included appearance, taste, aroma, consistency, and overall acceptability, all of which differed significantly ($p < 0.05$) among the samples. The mayonnaise formulated with 80% avocado oil and 20% pear oil recorded the highest mean scores across all attributes, indicating superior consumer preference. In contrast, the sample containing 70% avocado oil and 30% pear oil showed the lowest scores. These findings highlight the importance of key sensory attributes particularly appearance, taste, aroma, and texture in determining the acceptability of mayonnaise and similar emulsified food products, as they directly influence consumer perception and preference (Ogundele *et al.*, 2015). The mayonnaise sample containing 80:20 avocado to pear oil was rated

Frontier in Medical & Health Research

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higher than the control, suggesting that moderate inclusion of African pear oil can enhance sensory quality without compromising acceptability. Conversely, the 70:30 blend was least preferred and was generally rejected by the panelists, likely due to unfamiliar flavor characteristics associated with higher proportions of pear oil. This indicates that excessive substitution may negatively affect palatability. The results further confirm that taste remains the most critical determinant of food acceptance, as it ultimately influences consumer preference despite the initial appeal of other attributes such as appearance (Ojinnaka and Nnorom, 2015). Overall, the findings suggest that an optimal balance of avocado and pear oils can produce mayonnaise with desirable sensory qualities and high consumer acceptance.

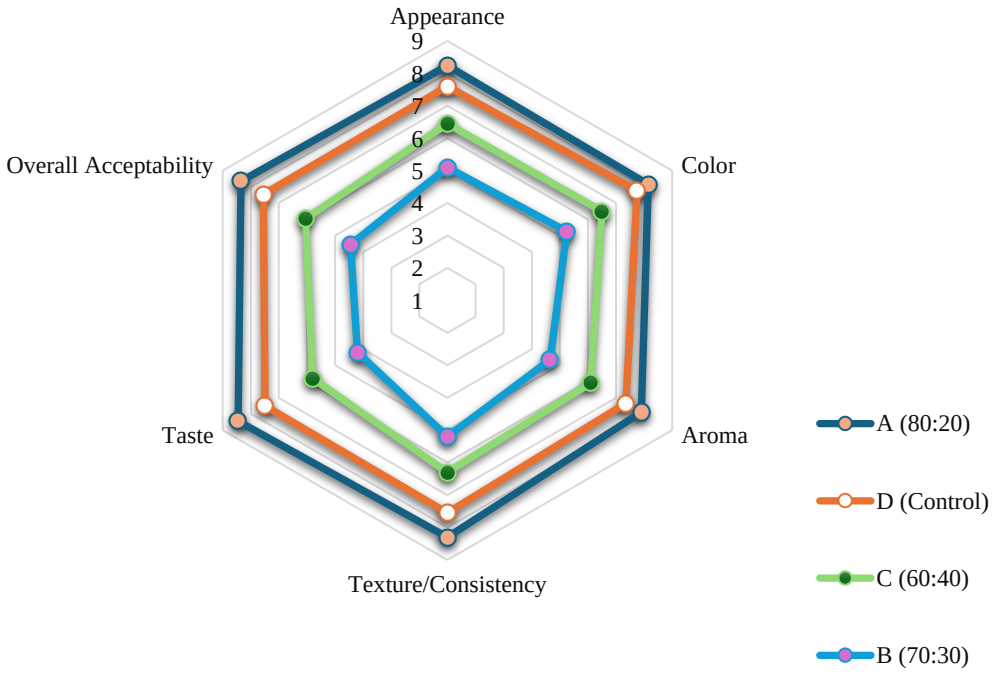


Figure 3: Radar plot showing the sensory profile of mayonnaise formulated with avocado and pear oil blends

4- Conclusion

This study evaluated the production and quality characteristics of mayonnaise formulated from blends of avocado (*Persea americana*) and pear (*Pyrus communis*) oils. The findings demonstrated that oil blending enhanced the overall physicochemical properties, fatty acid composition, and functional quality of the oils, although the relatively high free fatty acid content observed in pear oil indicates the need for further refining to meet Codex standards. The results confirm that both oils represent viable alternative sources of edible fats with promising industrial and nutritional potential. Mayonnaise produced from the oil blends exhibited improved proximate composition, particularly in ash, protein, and carbohydrate contents, alongside acceptable oxidative stability and low microbial loads, suggesting good shelf stability. Sensory evaluation revealed that most formulations were well accepted, with the 80:20 avocado to pear oil blend showing the highest preference, while excessive substitution (70:30) reduced acceptability. Based on these findings, it is recommended that improved and efficient oil extraction and refining techniques be adopted to optimize yield and quality; that avocado and pear oils be further explored and promoted as functional ingredients in food systems such as mayonnaise; and that increased research attention be given to the

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processing, preservation, and industrial utilization of pear oil.

Conflict of Interest

Authors declared that there were no conflicts of interest.

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