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Can rice bran, sesame, and olive oils be used as substitutes for soybean oil to improve French salad dressing quality?

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SUMMARY: Soybean oil is a commonly-used vegetable oil for the industrial manufacture of French salad dressing. The effect of rice bran, sesame, olive, and soybean oils on French salad dressing's quality characteristics was investigated. After one month, the highest acidity, peroxide value (PV), and the lowest emulsion stability were observed in the control containing soybean oil ($p < 0.05$). Samples formulated with sesame (T4) and rice bran oils (T3) had the lowest PVs. Color measurement results indicated that a* of a sample containing olive oil (T2) was most influenced and declined on the 30th day ($p < 0.05$). In the rheological test, samples were solid viscoelastic. The elastic modulus and complex viscosity of T2 were slightly higher. The highest and the lowest overall sensory acceptance belonged to T3 and T2, respectively. Therefore, soybean oil could be replaced to obtain a more desirable product. Finally, T3 was selected as the superior sample.

KEYWORDS: *French salad dressing; Olive oil; Rice bran oil; Sesame oil; Soybean oil*

RESUMEN: ***¿Se pueden usar aceites de salvado de arroz, sésamo y oliva como sustitutos del aceite de soja para mejorar la calidad del aderezo de ensaladas francesas?*** El aceite de soja es un aceite vegetal de uso común para la fabricación industrial de aderezo para ensaladas francesas. Se investigó el efecto de los aceites de salvado de arroz, sésamo, oliva y soja sobre las características de calidad del aderezo para ensaladas francesas. Después de un mes, la mayor acidez, el índice de peróxido (PV) y la menor estabilidad de la emulsión se observaron en el control que contenía aceite de soja ($p < 0,05$). Las muestras formuladas con aceites de sésamo (T4) y salvado de arroz (T3) tuvieron los PV más bajos. Los resultados de la medida del color indicaron que a* de una muestra que contenía aceite de oliva (T2) fue la más influenciada y disminuyó en el día 30 ($p < 0,05$). En la prueba reológica, las muestras fueron sólidas viscoelásticas. El módulo elástico y la viscosidad compleja de T2 fueron ligeramente superiores. La aceptación sensorial general más alta y más baja correspondió a T3 y T2, respectivamente. Por lo tanto, el aceite de soja podría reemplazarse para obtener un producto más deseable. Finalmente, se seleccionó a T3 como la muestra superior.

PALABRAS CLAVE: *Aceite de oliva; Aceite de salvado de arroz; Aceite de sésamo; Aceite de soja; Aderezo para ensalada francesa*

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1. INTRODUCTION

Salad is one of the most popular and frequently-consumed food products and have been more in demand in recent years as a healthy food. Salad dressings can be used to improve the flavor and increase the acceptance of salads by consumers (de Melo *et al.*, 2015; Ma and Boye, 2013; Manshadi *et al.*, 2019). Salad dressings are oil-in-water emulsions containing different fats (Paraskevopoulou *et al.*, 2007). French salad dressing formulation includes oil, vinegar, eggs, tomato paste, flavoring agents, and stabilizers (Yaghouti Moghaddam *et al.*, 2013). Due to USFDA, the amount of vegetable oil in salad dressings should be at least 30%. As a dispersed phase of the emulsion, the oil plays a significant role in shelf-life and the product's rheological, textural, and sensory properties (Ma and Boye, 2013). According to Amin *et al.* (2014), different types of oils (sunflower, soybean, corn, sesame, and olive) have a significant effect on the quality characteristics of mayonnaise. Vegetable oils extensively used in salad dressings include soybeans, canola, and sunflower oil (Amin *et al.*, 2014).

Soybean oil is one of the most commonly utilized oils in the industry to manufacture emulsified dressing due to its abundance and low cost (Neia *et al.*, 2019). However, it contains large amounts of unsaturated fatty acids, including linolenic acid, which reduces its stability against oxidation (Shahidi, 2005). Despite the restrictions of using peroxide value as the main factor for oil's shelf-life, it is usually used as an indicator of oil oxidation. An undesirable change may have occurred in the flavor of soybean oil at the peroxide value of 5-10 meqO_2/kg oil (Rasmussen *et al.*, 2008). Some oils, such as olive, sesame, and rice bran, are rich in oleic or linoleic fatty acids, and have less linolenic acid than soybean oil.

Moreover, due to the presence of natural compounds with potent antioxidant properties, oils have high nutritional value (Shahidi, 2005). Olive oil from the fruit of the *Olea europaea* tree is one of the healthiest and most useful vegetable oils. It has large amounts of unsaturated fatty acids, and the major one is oleic acid (Karbasian *et al.*, 2015). Olive oil, especially the extra virgin type, is rich in phenolic compounds with antioxidant activity (Di Mattia *et al.*, 2015; Karbasian *et al.*, 2015). Sesame oil contains a high concentration of unsaturated fatty acids such as linoleic and oleic acid. However, its oxidation stability is high due to highly antioxidant compounds such as sesamol, sesamolin, and tocopherol (Pazhvand and Khavarpour, 2019). Rice bran oil is a byproduct of rice that has high nutritional value. Most of its fatty acids are unsaturated, and its dominant acid is oleic acid with gamma oryzanol as an antioxidant compound (Garcia *et al.*, 2009; Phan *et al.*, 2019). Due to previous studies, rice bran oil showed good potential for use as an alternative to soybean oil in mayonnaise formulation (Garcia *et al.*, 2009). In addition, according to the results of Pazhvand and Khavarpour (2019), using 20% sesame oil in mayonnaise formulation is suitable for improving its nutritional value (Pazhvand and Khavarpour, 2019). Most previous research on French salad dressings has focused on stabilizing (Yaghouti Moghaddam *et al.*, 2013) and emulsifying compounds (de Melo *et al.*, 2015), but the effect of different types of oils has not been compared. This study aimed to compare the effects of olive, sesame, rice bran, and soybean oils on the quality characteristics of French salad dressings in order to select a more desirable product.

2. MATERIALS AND METHODS

2.1. Preparation of French salad dressing

The ingredients used in the formulation of samples include eggs (10%), vinegar (8%), oil (36%), salt (2%), tomato paste (6.2%), garlic powder (0.04%), pepper powder (0.08%), citric acid (0.1%), xanthan gum (0.15%) (GRINDSTED, Danisco, Denmark), Guar gum (0.05%) (GRINDSTED, Danisco, Denmark), sodium benzoate (0.06%), potassium sorbate (0.01%), and water (31.31%). The vegetable oils included sesame oil (Pick, Iran), rice bran oil (Gaetano Giurlani, Italy), soybean oil (Olitaia, Italy), and olive oil (Villa Vinci, Italy) and were purchased from a local market in Tehran.

For sample preparation, tomato paste was mixed with spices in water, pasteurized at 90 °C for 30 minutes and then cooled. A part of pasteurized phase was mixed with powdered materials and eggs. Then, half of the oil was added gradually to form the emulsion. After that, the rest of the pasteurized phase, vinegar, and remaining oil were added and the mixture was well blended. Finally, French dressing samples were poured into glass containers and stored at 4 °C (Yaghouti Moghaddam *et al*., 2013). Analyses were performed on the first, fifteenth, and 30th days, and a sensory test was performed on the first and 30th days of storage.

2.1.1. Edible oils' chemical analyses

The iodine (IV), peroxide (PV), anisidine (AV) values, and free fatty acids (FFA) of the samples were determined according to the AOCS official method (Firestone, 2009). Fatty acids were converted to fatty acid methyl esters through the transesterification of oils with sodium methoxide according to the AOCS method (Ce 1–62). The fatty acid methyl esters in the samples were analyzed on a Gas Chromatograph (GC) equipped with a mass spectrometry (AOCS, 2009).

2.2. Physicochemical properties

The pH was measured by Lohand-PHS-550-China. The analyses of the acidity and peroxide values in the sauces were performed according to ISO 660:2011 and ISO 3960:2010, respectively (ISO 660, 2020; ISO 3960, 2010). In the emulsion stability test, 10 g of sample (F_1) was transferred to a tube and heated in a water bath at 80 °C for 30 min. Then, the samples were centrifuged (PIT320-Universal, Iran) at 3000 rpm for 15 min, and the top layer of oil was removed. The precipitated layer was weighed (F2), and the emulsion stability was calculated as follows: $\frac{F2}{F1} \times 100$ (de Melo *et al.*, 2015; Nikzade *et al.*, 2012). All the above measurements were performed in triplicate with the preparation of three treatments per sample.

2.3. Color measurement

Colorimetry was accomplished using a HunterLab colorimeter (TES, Taiwan). The experiments were performed 5 times for each sample at different angles, and L*, a*, and b* parameters were measured (de Melo *et al.*, 2015).

2.4. Rheological properties

A dynamic test was performed using a modular compact rheometer (MCR302, Anton Paar, Austria) at 25 ºC with a parallel-plate configuration (diameter: 25 mm) and a gap distance of 1 mm. For the amplitude sweep test, 1 rad/s frequency was considered constant to determine the linear viscoelastic region, and the strain value applied to the samples ranged from 0.01 to 100%. The frequency sweep test was performed under the linear viscoelastic region, and the frequency range from 0.01 to 100 rad/s was applied to the samples (Di Mattia *et al.*, 2015).

2.5. Sensory evaluation

Ten semi-trained panelists performed sensory tests on days 1 and 30 after production. The taste, odor, color, texture before use, oral texture, and overall acceptance were evaluated. Before this test, the microbial characteristics of samples were confirmed according to Iran National Organization of Standardization (INSO) No. 2965 (Microbiology of mayonnaise and salad sauce- Specifications and test methods) (INSO 2965, 2017). Then the samples with different three-digit codes were given randomly to the panelists. Panelists evaluated each sample in duplicate. A comparison of sensory indices was performed with the 9-point hedonic scale from 1 (strongly disliked) to 9 (strongly liked) (de Melo *et al.*, 2015).

2.6. Statistical analysis

Data were analyzed by SPSS 24 using one-way analysis of variance (ANOVA), and the differences among means were determined by Duncan's multiple range test at $p < 0.05$.

3. RESULTS AND DISCUSSION

3.1. Fatty acid composition and chemical characteristics of selected oils

The results indicated that olive oil had the lowest Iodine value (86.4 ± 0.11 g I_2/100 g oil) and was more saturated in comparison with other oils because olive oil had the highest oleic acid (C18:1) and lowest linoleic (C18:2) and linolenic (C18:3) contents compared to the other oils used in this study (Table 1). In contrast with olive oil, soybean oil had the highest unsaturation or iodine value (128.25 ± 0.34 g I_2/100 g oil) among the oils and the highest polyunsaturated fatty acids (linoleic and linolenic acids). For this reason, soybean oil is more susceptible to oxidation. Primary and secondary oxidation

Table 1. Fatty acid composition and chemical characteristics of soybean, sesame, rice bran, and olive oils[a]

	Soybean	Sesame	Rice bran	Olive oil
Palmitic acid (C16:0)	11.45±0.07	8.80±0.12	21.70±0.33	15.16±0.26
Stearic acid (C18:0)	4.90±0.33	5.05±0.04	1.20±0.02	2.30±0.02
Oleic acid (C18:1)	22.88±0.61	37.01±0.55	43.05±0.78	65.05±0.81
Linoleic acid (C18:2)	52.22±0.74	47.55±0.35	29.90±0.24	13.45±0.43
Linolenic acid (C18:3)	7.51±0.05	1.34±0.07	2.10±0.06	1.05±0.02
Others	1.04±0.02	0.25±0.01	2.05+0.07	2.99±0.05
Iodine Value (g I_2/100 g oil)	128.25± 0.34	116.38± 0.05	101.34± 0.20	86.40±0.11
Peroxide value (meq/kg)	1.39± 0.01	1.02± 0.02	0.75± 0.07	1.20± 0.02
Anisidine value	3.20± 0.03	1.97± 0.02	2.49±0.05	3.20± 0.01
Free fatty acids (%)	0.41±0.00	0.42±0.02	0.70±0.14	0.30±0.00

[a] Each value in the table represents the mean value ± standard deviation of triplicate analyses.

products (PV and AV) and FFA are given in Table 1. The primary products of hydrolytic rancidity (FFA) are not toxic. However, they accelerate oil oxidation, which leads to a similar toxic effect of oxidized oils (Hosseini *et al.*, 2020).

3.2. Physicochemical properties

The results of the chemical properties in French salad dressing samples are shown in Table 2. The results showed a negligible difference among the samples' pH only on the first day of storage ($p < 0.05$). Acording to Pazhvand and Khavarpour (2019), the addition of different amounts of sesame oil to mayonnaise caused small changes in samples' pH. Chetana *et al.* (2019) also stated that the pH of egg-free mayonnaise containing sesame oil and rice bran oil was not affected by oil mixtures. According to the Commercial Item Description (CID) of The U.S. Department of Agriculture (USDA) (A-A-20140E), the pH requirement for salad dressing is not less than 3.1 or more than 4.1 (USDA, 2017). In addition, based on the Iran National Organization of Standardization (INSO) No. 2454, the pH of salad dressing should be a maximum of 4.1 (INSO 2454, 2014). In this study, the pH of all of the French salad dressing samples was in line with the two mentioned standards, except T2 (containing olive oil) on the 1st day, which was not significantly different from T4 (containing sesame oil) on the same day. The pH of French salad dressing samples containing olive, rice bran, and sesame oils significantly decreased during storage ($p < 0.05$). Besides, acidity increased after one month of storage, and T1 (containing soybean oil) had significantly higher acidity on the 30th day ($p < 0.05$), and other samples were not significantly different ($p > 0.05$). Reducing pH and increasing the acidity may

Table 2. pH, acidity, and peroxide values of French salad dressing formulations during storage (n=3, mean ± SD)

	pH			Acidity (%)			PV (meq/kg)		
Sample	Day 1	Day 15	Day 30	Day 1	Day 15	Day 30	Day 1	Day 15	Day 30
T_1	$4.08^{bAB}\pm0.01$	$4.09^{aA}\pm0.00$	$4.06^{aB}\pm0.01$	$2.55^{bC}\pm0.03$	$2.78^{aB}\pm0.03$	$3.12^{aA}\pm0.07$	$0.19^{aC}\pm0.01$	$0.23^{aB}\pm0.01$	$0.29^{aA}\pm0.01$
T_2	$4.11^{aA}\pm0.00$	$4.09^{aAB}\pm0.00$	$4.07^{aB}\pm0.01$	$2.62^{abB}\pm0.02$	$2.68^{bAB}\pm0.02$	$2.77^{bA}\pm0.04$	$0.16^{bB}\pm0.01$	$0.22^{aA}\pm0.01$	$0.25^{bA}\pm0.00$
T_3	$4.08^{bA}\pm0.01$	$4.10^{aAB}\pm0.01$	$4.07^{aB}\pm0.01$	$2.45^{cC}\pm0.02$	$2.73^{abB}\pm0.03$	$2.87^{bA}\pm0.05$	$0.16^{bC}\pm0.00$	$0.18^{bB}\pm0.00$	$0.21^{cA}\pm0.01$
T_4	$4.10^{abA}\pm0.01$	$4.08^{aB}\pm0.00$	$4.07^{aB}\pm0.00$	$2.67^{aB}\pm0.03$	$2.80^{aA}\pm0.03$	$2.87^{bA}\pm0.05$	$0.10^{cC}\pm0.00$	$0.16^{bB}\pm0.00$	$0.20^{cA}\pm0.00$

Each sample includes different oil: T1: soybean oil, T2: olive oil, T3: rice bran oil, T4: sesame oil. Mean values with the same superscript lowercase and uppercase letters are not significant at $p > 0.05$ in each identical column and row, respectively (according to one way ANOVA and Duncan's multiple range test).

be due to oil oxidation and the formation of hydroperoxides and the hydrolysis of triglycerides, as well as the creation of free fatty acids (de Melo *et al.*, 2015). Another reason for the decreased pH may be related to increased microbial growth, especially lactic acid bacteria (Pazhvand and Khavarpour, 2019). The results of the acidity of French salad dressing samples were in accordance with the minimum percentage of acidity of salad dressings in INSO No. 2454, which is 0.6% (INSO 2454, 2014). According to the results shown in Table 2, the highest peroxide value was obtained for the sample containing soybean oil (T1), which was significantly different from other samples on the first and 30th days and for T3 (containing rice bran oil) and T4 (containing sesame oil) on 15th day ($p < 0.05$). The peroxide value of the samples significantly increased during one month of storage, which is in line with the results of Abedinzadeh *et al.* (2016). After one month, the lowest peroxide value was observed in T4 and T3 samples, which showed no significant difference ($p > 0.05$). Oil oxidation occurs on the surface of oil droplets in oil-in-water emulsions. The reaction among hydroperoxides on the surface of oil droplets as the primary products of oxidation and metals transferred from the aqueous phase is the main reason for oxidative instability. The mechanism is the breakdown of hydroperoxides into free radicals, which react with unsaturated fatty acids inside oil droplets or at the water-oil interface, which results in the production of free radical (Paraskevopoulou *et al.*, 2007). Soybean oil is more susceptible to oxidation compared to the other three oils, as it contains about 7-8% linolenic acid (C18:3) (Kim *et al.*, 2010). Sesame oil has phenolic compounds of lignans such as sesamine, sesamolin, and sesaminol, which have strong antioxidant activity (Pazhvand and Khavarpour, 2019). The oxidative stability of rice bran oil may also be due to phenolic compounds such as gamma-oryzanol (Garcia *et al.*, 2009). Therefore, the presence of strong antioxidant compounds in sesame and rice bran oils can reduce oxidation. The presence of polyphenolic compounds in olive oil, which have antioxidant properties and high oleic acid content (monounsaturated), significantly decreased the peroxide value of T2 on day 30 compared to T1 (Di Mattia *et al.*, 2015; Karbasian *et al.*, 2015).

The results of emulsion stability are presented in Figure 1. The sample containing soybean oil had the lowest stability on all days. After one month of storage, three samples containing olive, sesame, and rice bran oils were not significantly different ($p > 0.05$). The existence of thickeners in the formulation of food emulsions is an essential factor which could affect the emulsions' stability. Adding xanthan gum can improve emulsion stability (Ma and Boye, 2013). However, since the type and amount of thickener in the samples were the same, the difference in emulsion stability is related to the type of oil used in the formulation, which is in line with the results of Chetana *et al.* (2019). The type of fatty acids in oils affects the stability of emulsions. Oils with

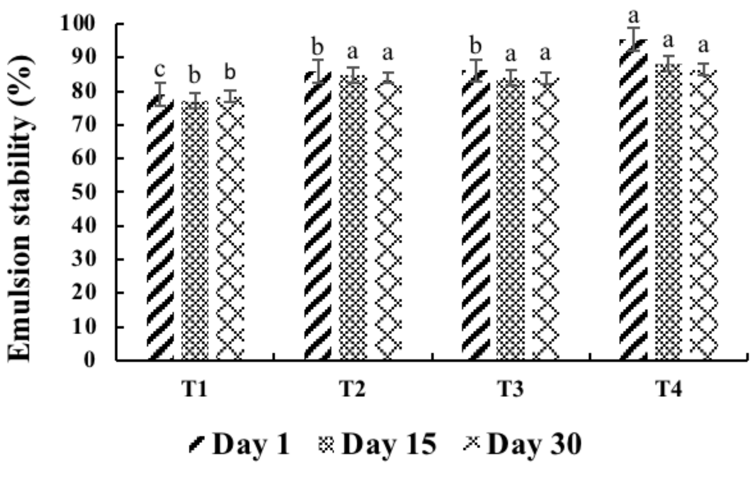

Figure 1. Emulsion stability of French dressing samples during storage. Each sample includes different oils: T1: soybean oil, T2: olive oil, T3: rice bran oil, T4: sesame oil. The same superscript letters are not significant at p > 0.05 on identical days (according to one-way ANOVA and Duncan's multiple range test).

large amounts of unsaturated fatty acids cannot create a strong structure (Kim *et al.*, 2010). Therefore, French salad dressing with soybean oil, which contains large amounts of unsaturated fatty acids such as linolenic acid, showed lower stability.

3.3. Color measurement

According to the results of the color analysis shown in Figure 2, L* (lightness/darkness) of T4 (containing sesame oil) was significantly lower than T3 (containing rice bran oil) and T2 (containing olive oil) on the first day of storage ($p < 0.05$). The results of Chetana *et al*. (2019) showed that the mayonnaise sample prepared with sesame oil had a lower L* than the sample formulated with rice bran oil. On day 30, the highest and lowest L* values were observed in T3 (containing rice bran oil) and T2, respectively. Moslavac *et al.* (2012) stated that olive oil also caused the lowest L* value after one month in mayonnaise. The a* value (redness) of T2 (containing olive oil) was lower than some samples such as T1 (containing soybean oil), due to the specific color and slightly greenish olive oil. Moslavac *et al.* (2012) showed that adding olive oil to the formulation of mayonnaise reduced its redness, consistent with the present study. The highest b* value was obtained in T1. The samples containing rice bran and sesame oils (T3 and T4) had the lowest b* on day 30. The results of Chetana *et al.* (2019) showed a significant difference in b* in mayonnaise samples with different ratios of sesame and rice bran oils compared to mayonnaise containing sunflower oil.

3.4. Rheological tests

The maximum strain in the linear viscoelastic region for French salad dressing samples was 1%. The trend of changes in elastic modulus (G') and viscose modulus (G") compared to frequency is shown in Figure 3. In all samples, the elastic modulus (G') was higher than the viscose modulus (G"), indicating more elastic behavior than viscose, and all samples were solid viscoelastic. Furthermore, they are classified as weak gel due to the dependence of elastic and viscose modulus on frequency

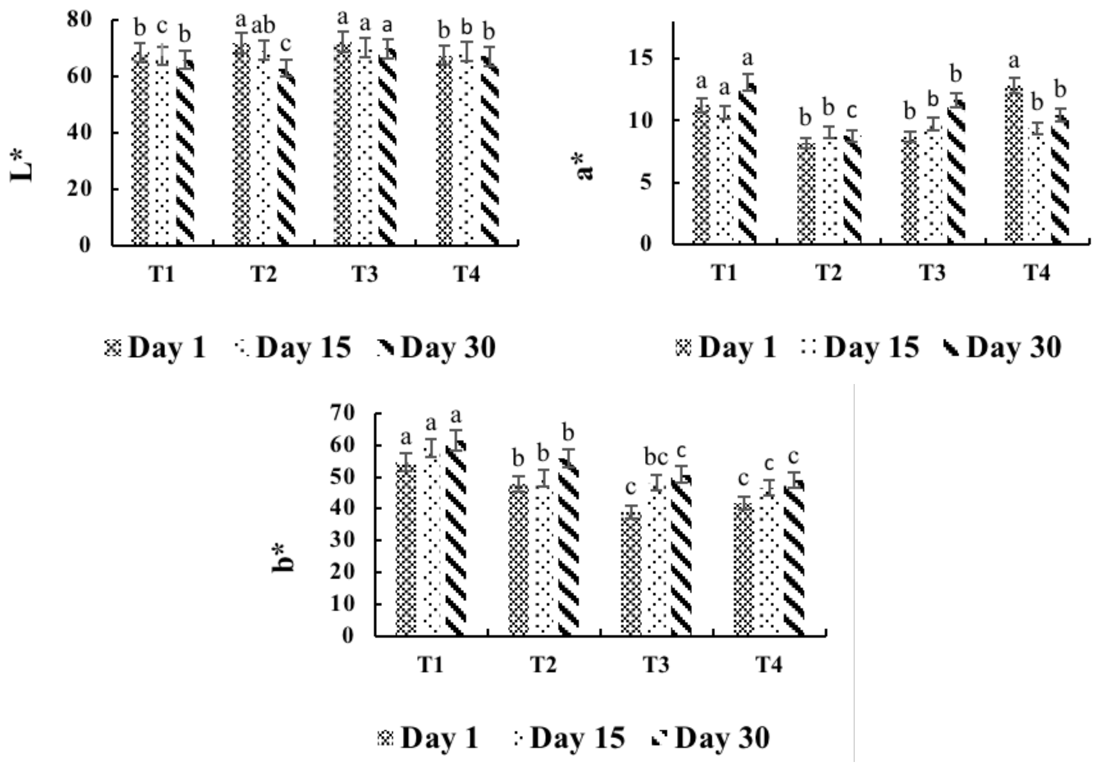

FIGURE 2. Color values for French salad dressing during storage. Each sample includes different oils: T1: soybean oil, T2: olive oil, T3: rice bran oil, T4: sesame oil. The same superscript letters are not significant at p > 0.05 on identical days (according to one- way ANOVA and Duncan's multiple range test).

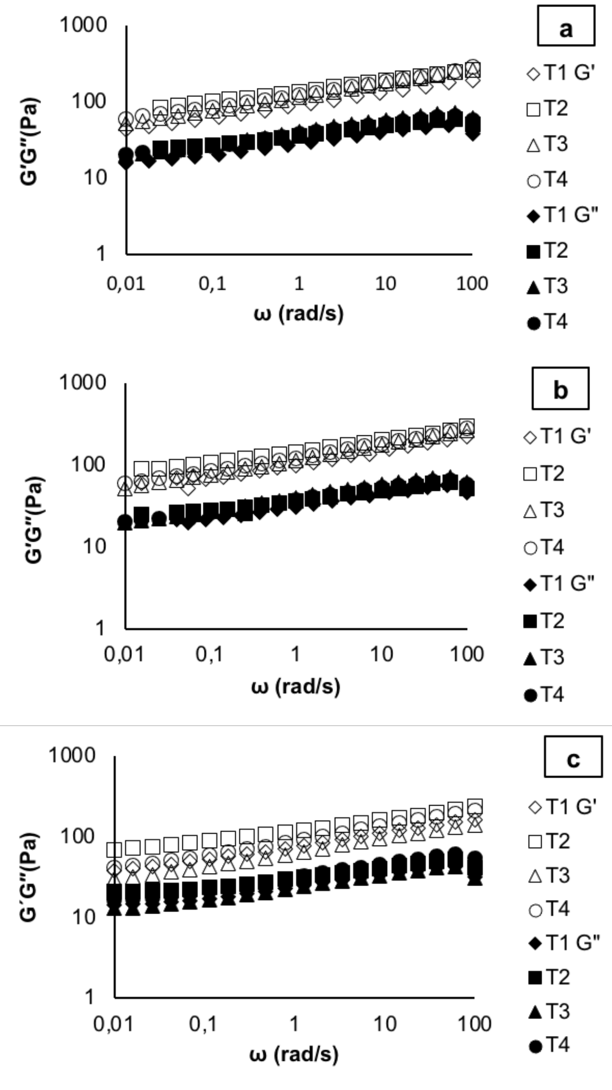

Figure 3. Rheogram of Storage modulus (G ') and loss modulus (G'') versus frequency in French salad dressing samples after (a) 1 day (b) 15 days and (c) 30 days. Each sample includes different oils: T1: soybean oil, T2: olive oil, T3: rice bran oil, T4: sesame oil.

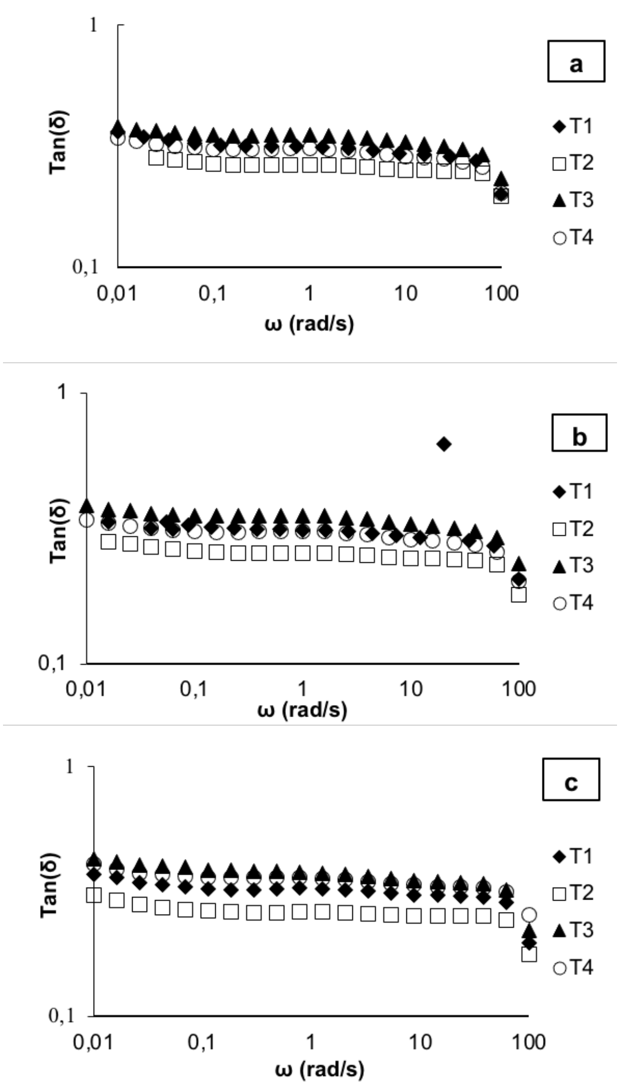

Figure 4. Tan (δ) of French salad dressing samples after (a) 1 day (b) 15 days and (c) 30 days. Each sample includes different oils: T1: soybean oil, T2: olive oil, T3: rice bran oil, T4: sesame oil.

as in previous studies (Bortnowska *et al.*, 2014; Mizani *et al.*, 2015). Since the type and amount of xanthan gum as stabilizer was constant, the type of oil used in the formulation affected the rheological factors. T2 (containing olive oil) had a slightly higher elastic modulus in all three days of storage. Tan (δ), which indicates the superiority of elastic or viscous properties (Bortnowska *et al.*, 2014), was obtained under 1 and indicated solid viscoelastic behavior (Figure 4). The changes in complex viscosity (*η) of samples compared to frequency are shown in Figure 5. The samples' complex viscosity decreased by increasing frequency, indicating the pseudoplastic behavior, which is due to weak gel structure and in accordance with other studies (Bortnowska *et al.*, 2014; Mizani *et al.*, 2015). The complex viscosity was slightly higher in T2 (containing olive oil) and T4 (containing sesame oil) than in the other samples. On all days, the elastic modulus and complex viscosity of the T2 sample (with olive oil) were slightly higher than other samples. The composition of fatty acids in oils (oleic and linoleic) has an important effect on rheological behavior. The viscosity decreases in oils by increasing the ratio of linoleic to oleic acids. This phenomenon represents more double bonds in the chain. Since each

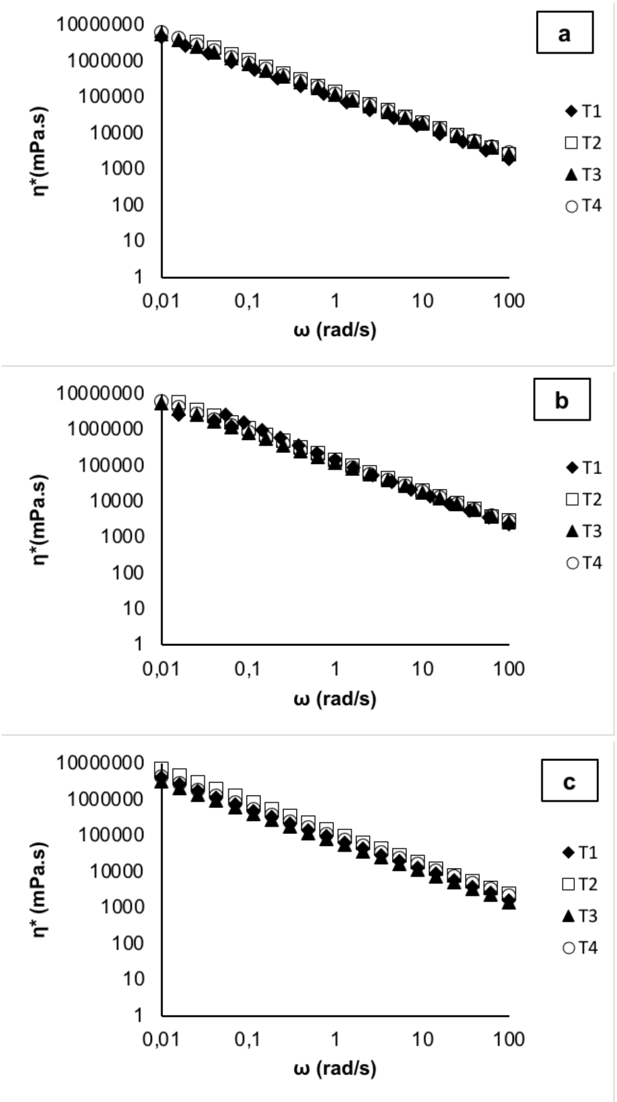

FIGURE 5. Complex viscosity (*η) of French salad dressing samples after (a) 1 day (b) 15 days and (c) 30 days. Each sample includes different oils: T1: soybean oil, T2: olive oil, T3: rice bran oil, T4: sesame oil.

double bond with cis arrangement creates a sprain in the chain, the double band's presence prevents the molecules from approaching each other (Kim *et al.*, 2010). Therefore, olive oil, which contains large amounts of oleic acid and has a high oleic to linoleic ratio, had higher elastic behavior, complex viscosity, and higher structural strength. The qualitative characteristics of the different ratios of olive, sesame, and linseed oil mixture ratios were evaluated by Hashempour-Baltork *et al.* (2018). The results showed that increasing linseed oil reduced the viscosity due to highly unsaturated fatty acids.

3.5. Sensory evaluation

The results of the sensory evaluation of French dressing samples are shown in Figure 6. The samples containing rice bran (T3) and sesame (T4) oils had higher scores for taste and odor on the 1st and 30th days after production, and a lower score belonged to T2 (olive oil). According to Di Mattia *et al.* (2015), the addition of extra virgin olive oil to mayonnaise was also associated with bitterness and astringency related to phenolic compounds (Di Mattia *et al.*, 2015). T2 had the lowest color score on the first day and after one month of storage. There was no significant difference in texture before use ($p > 0.05$), and there was little difference in oral texture among the samples after consumption ($p < 0.05$). Finally, T3 (rice bran oil) had higher overall acceptance, and the lowest acceptability was observed in T2 on days 1 and 30. Chetana *et al.* (2019) also stated that eggless mayonnaise samples formulated with rice bran oil had the highest overall acceptance compared to samples containing a mixture of rice bran and sesame oil and a sample containing sunflower oil. Amin *et al.* (2014) produced low-fat mayonnaise samples containing different oils. They stated that samples with soybean and sunflower oils were more sensorial acceptable compared to those containing corn, sesame, and olive oils. Samples containing olive and sesame oils had a lower color score.

4. CONCLUSIONS

This study's results showed that the quality characteristics of French salad dressing were influenced by the oil used in the product. Although soybean oil is one of the most widely used oils in the formulation of many commercial dressings, it causes higher peroxide value, acidity, and lower emulsion stability during storage. Since the sample containing rice bran oil had the highest sensory acceptability and other acceptable results, it was selected as the superior sample. Therefore, it is possible to use oils with higher nutritional value such as rice bran oil in French salad dressing to improve the product's quality. Future research could be conducted about the effect of oils with high nutritional value on increasing the antioxidant properties in salad dressings.

Compliance with ethical standards

The authors declare that there is no conflict of interest.

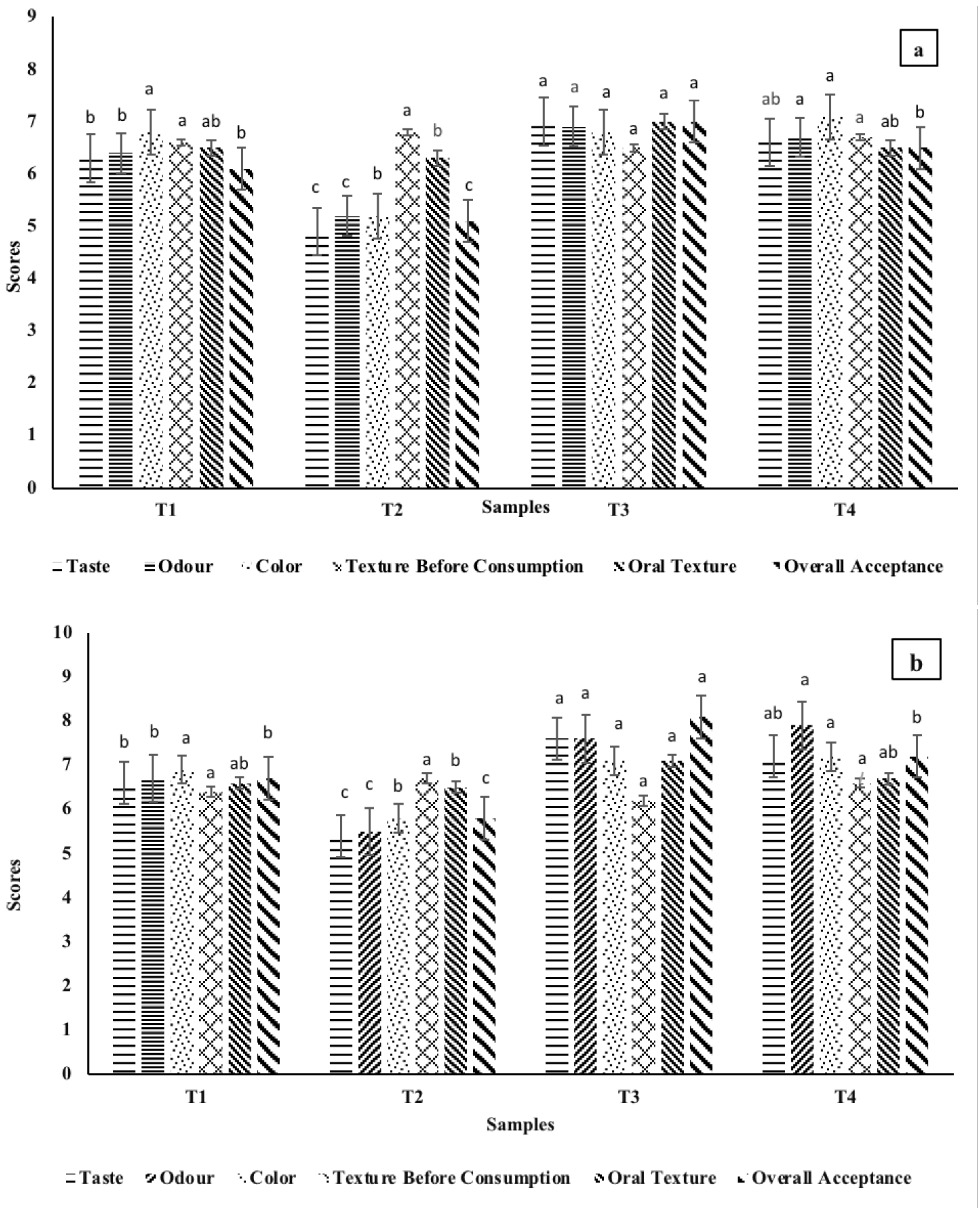

FIGURE 6. Sensory characteristics of French salad dressing samples on the days 1 (a) and 30 (b) after production. Each sample includes different oils: T1: soybean oil, T2: olive oil, T3: rice bran oil, T4: sesame oil. The same superscript letters are not significant at $p > 0.05$ for each sensory attribute on identical days (according to one- way ANOVA and Duncan's multiple range test).

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