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Storage Stability of Groundnut Oil and Soya Oil-Based Mayonnaise

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Abstract: The objectives of this study are the production of mayonnaise from groundnut and soya oils and the determination of the storage stability of the mayonnaise by monitoring the development of rancidity and increase in peroxide values. Mayonnaise was prepared from groundnut and soya oils with the level of oils varied from 65-78%. The mayonnaise produced was stored for a period of 6 weeks and then analyzed for changes in free fatty acid (FFA) and peroxide values. The results showed that on storage the peroxide values of the mayonnaise products increased. This shows their susceptibility to go rancid with time. It was also found out that the 65 and 78% soya oil mayonnaise had shelf-life of 40 days and 32 days, respectively while the 65 and 78% groundnut oil mayonnaise had shelf-life of 34 days and 26 days in that order at room temperature. Sensory evaluation carried out by a team of panelists on the mayonnaise products showed that mayonnaise produced from 65% soya and groundnut oils was more preferred to that produced from 78% soya and groundnut oils.

Key words: Free fatty acid, groundnut oil, mayonnaise, peroxide value, shelf-life, soya oil, storage stability

INTRODUCTION

Mayonnaise comes under the class of foods commonly referred to as salad dressings or salad cream. In Nigeria, the consumption of salad dressings has increased tremendously in the last 30-40 years principally because of their widespread adoption as spreads for bread as well as other uses. A salad dressing is an oil-in-water emulsion where oil is the discontinuous phase and water is the continuous phase. Mayonnaise is a semi-solid emulsion of edible vegetable oil, egg yolk or whole egg, acidifying ingredients (vinegar, lemon or lime juice), seasoning (e.g. salt, sweeteners, mustard, paprika), citric acid and maleic acid to preserve its colour and flavour. It is less perishable than butter or margarine, more mobile, easy to handle and fast to spread. The finished product, mayonnaise, contains about 65% and above of edible vegetable oil. Since mayonnaise consists largely of oil, its production actually depends on or represents a method of converting liquid oil to a plastic product competitive with butter and margarine. In the production of mayonnaise, the choice of oil is very important and the oils used are referred to as salad oils. In some cases the oil used are different from the normal cooking oils. Salad oils usually remain substantially liquid when refrigerated at 4.5-7.2°C and produces mayonnaise which is stable at relatively low temperatures (Finberg, 1995).

In Nigeria, some of the major oil sources are palm oil, groundnut oil, palm kernel oil, soyabean oil and melon seed oil. Kolowsky (1993) showed that salad oil can be prepared from palm oil by fractional crystallization method in isopropyl alcohol. Despite the fact that salad dressing is much consumed in Nigeria, not much attention has been given to its development from local oils. The suitability of groundnut oil for preparation of a stable mayonnaise emulsion is not very certain. Different researchers appear to have different ideas about groundnut oil as a salad oil. Weiss (1990) stated that groundnut oil solidifies to an extent that it cannot be winterized hence it cannot be used for salad dressings. Binsted *et al*. (1983) on the other hand enumerated groundnut oil as one of the salad oils in use. Winterization is used to remove the higher melting glyceride of oil before it may be classified as a salad oil (Mattil, 1984). The standard method of evaluating the winterization of salad oils is the cold test of the American oil chemist's society (Mounts *et al*., 1981). Other tests usually carried out on oils to be used as salad dressing and mayonnaise are: organoleptic (checking of flavour and odour), free fatty acid, peroxide value and colour.

Free fatty acid test serves as a quality factor. The presence of free fatty acid in oil is an indication of lipase activity or other hydrolytic action (Brown and Morton, 1989) and is important in order to obtain maximum shelf

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life or storage stability of the finished product (mayonnaise). Peroxide value indicates the degree of rancidity and provides a measure of the prospective life of the oil. It shows the influence of air, light and time on the oil and measures the amount of oxidation due to these factors at any specific time. It is generally thought that peroxides arise in vegetable oils from the attack by oxygen on the-CH_2-group between carbon double bonds. These hydrogen atoms are reactive and peroxides are formed. The breakdown of peroxides can be catalyzed by acids or heat and yields a number of other breakdown products, which contribute to the flavour, pleasant or otherwise of oxidized oils. Rancidity is sometimes a problem with salad cream products because lipolytic enzymes (lipases) split fats/oils to give free fatty acids. This is hydrolytic rancidity and oxidative enzymes catalyze the oxidation of oil by the atmospheric oxygen and the degraded fatty acid radiation gives rise to volatile substance with objectionable odour/flavour (Binsted *et al*., 1983).

This study was therefore aimed at resolving the important question about the suitability of some indigenous oils for salad dressing manufacture. The objectives of this work are the production of mayonnaise from groundnut oil and soya oil and the determination of the storage stability of the mayonnaise by monitoring the development of rancidity and increase in peroxide values.

MATERIALS AND METHODS

Two types of salad oil-groundnut oil and soya oil were used in this study. Groundnut oil and bottled Soya oil were purchased from the salad super markets, Area II Garki Abuja, Nigeria.

White spirit (vinegar) was purchased form Amigo super market, Wuse II Abuja. Sugar, salt, white pepper and mustard cream were all purchased from Wuse market in Abuja.

The winterization of both the groundnut oil and soya oil was evaluated using the cold test of the American oil chemist society (Mounts *et al*., 1981). The acetic acid strength of the vinegar used was determined using the method described by Binsted *et al*. (1983).

To produce the mayonnaise, the oils and other materials were chilled to a temperature range of 15.5-21.1°C. First, the egg yolk, sugar, salt, pepper and a third of vinegar were placed in the mixing bowl of a Kenwood mixer and mixed. The oil was beaten gradually; the mixture was thinned by mixing in the remainder of the vinegar. Mixing was carried out using the Armfield homogenizer for about 3 min at a pressure of 750 N mG^2. The recipe for the production of the mayonnaise is shown in Table 1. Samples of the mayonnaise produced were placed at different temperatures; some were placed in the refrigerator at 12°C while the other samples were kept in a cupboard at room temperature of 30°C. The time taken for oil separation to begin was observed.

Table 1: Recipe for the production of the mayonnaise

Ingredients	65 % Oil	78 % Oil
Vinegar (4.5% acetic acid)	8	9.4
Egg yolk	6	7
Salt	1	1.5
Mustard	0.5	1.5
White pepper	0.1	0.15
Sugar	1.0	1.15

Chemical analysis: The peroxide and free fatty acid values of the mayonnaise were determined using the Association of Official Analytical Chemists (AOAC, 1984) guidelines. These chemical parameters were expressed as milliequivalent/kg sample.

Sensory evaluation and acceptability test: Freshly prepared samples of groundnut oil and soya oil-based mayonnaise were coded and subjected to sensory test at first week and second week after production using trained panelists. Attributes tested for by the panelists were taste, colour, aroma and spreadability. The samples were served at room temperature with bread and water was taken in between to remove after taste. The sensory evaluation was carried out in a very conductive atmosphere and communication was prevented between the panelists to ensure accurate results. The panelists followed sensory evaluation and acceptability tests strictly and they wrote down their comments. They were given a questionnaire that has hedonic scale of seven behavioural orders of 7 (likes extremely), 6 (likes moderately), 5 (likes slightly), 4 (either likes or dislikes), 3 (dislikes slightly), 2 (dislikes moderately) and 1 (dislikes extremely) to fill. The samples were coded as follows:

- 542 and 501 represent 78% groundnut oil mayonnaise.
- 544 and 502 represent 78% soya oil mayonnaise.
- 541 and 503 represent 65% groundnut oil mayonnaise.
- 543 and 504 represent 65% soya oil mayonnaise.

RESULTS AND DISCUSSION

Evaluation of winterization of the oils: The winterization of the oils showed that after 5.5 h the soya oil remained clear, while the groundnut oil had solidified into thick cloudy lumps, which disappeared after the oil was removed from ice bath. From the results of the test, it was evident that the soya oil is a good salad oil and does not

need winterization before the production of salad oil, whereas groundnut oil is not suitable as a salad oil without been winterized. The winterization test is very important because oil which solidifies at refrigerator temperature will always result in a mayonnaise with a broken emulsion as soon as the oil begins to crystallize (Pearson, 1990).

Chemical analysis of groundnut oil and soya oil based-mayonnaise: Table 2 shows the changes in free fatty acid values of mayonnaise on storage and the changes in peroxide values of mayonnaise during storage are shown in Table 3.

Effect of storage period on free fatty acid of mayonnaise: Free fatty acid values were monitored for groundnut oil and soya oil-based mayonnaise for a period of 6 weeks. The values were found to be within the range cited in literature by Eckey (1986) that the usual range of free fatty acid values of groundnut oil and soya oil should be between 0.08-6.00. The values obtained were observed to increase as the weeks progressed. This increase in free fatty acid indicates the presence of the enzyme lipase. The results showed that over the period of 6 weeks for the 65% groundnut oil-based mayonnaise the highest value of 2.40 was obtained but initially it was 0.73 which was less than the value for 78% groundnut oil-based mayonnaise at first week. On further storage, it was observed that the FFA for both the 65% groundnut oil and 78% groundnut oil-based mayonnaise increased with time. Similar trends exist for the soya oil based-mayonnaise at 65 and 78% Soya oil. However, the values for the soya oil are correspondingly smaller. This trend is in agreement with the findings of Finberg (1995).

Effect of storage period on peroxide values of mayonnaise: The Peroxide values of the groundnut oil and soya oil-based mayonnaise were monitored for a period of 6 weeks.

Table 2: Changes in free fatty acid values of mayonnaise during storage

Week	65% Groundnut Oil, meq kgG^{1}	78% Groundnut Oil, meq kgG^{1}	65% Soya Oil, meq kgG^{1}	78% Soya Oil, meq kgG^{1}
1	0.73	1.13	0.65	0.68
2	0.87	1.58	0.74	0.71
3	1.52	1.74	0.96	0.93
4	1.87	2.06	1.39	1.24
5	2.14	2.53	1.65	1.53
6	2.40	2.91	1.81	1.72

Table 3: Changes in peroxide values of mayonnaise during storage

Week	65% Groundnut Oil, meq kgG^{1}	78% Groundnut Oil, meq kgG^{1}	65% Soya Oil, meq kgG^{1}	78% Soya Oil, meq kgG^{1}
1	0.87	0.89	0.69	0.78
2	1.63	1.81	1.47	1.58
3	2.97	2.91	2.54	2.66
4	3.28	3.43	3.08	3.14
5	3.96	4.08	3.76	3.83
6	4.82	5.23	4.55	4.73

It was observed that all the values were less than 10 indicating that the mayonnaise samples were safe. Pearson (1990) stated that a rancid taste begins to be noticeable when oil has peroxide values of 10-20. The peroxide values (Table 3) were noticed to increase gradually over the weeks indicating that mayonnaise gets rancid gradually on storage (Finberg, 1995). Also, 65% soya oil-based mayonnaise is more stable than its 65% groundnut oil-based counterpart. The same is true when 78% soya oil-based mayonnaise is compared with that of 78% groundnut oil-based mayonnaise. It was also found out that the 65 and 78% soya oil mayonnaise had shelf-life of 40 days and 32 days at room temperature, respectively while the 65 and 78% groundnut oil mayonnaise had shelf-life of 34 days and 26 days in that order at room temperature.

Sensory evaluation and acceptability test results: The sensory evaluation and acceptability test results for taste, colour, aroma and spreadability are presented in Table 4-7, respectively while the total scores for groundnut oil and soya oil mayonnaise acceptance are presented in Table 8. Table 8 shows that the mayonnaise produced from soya oil was preferred to the groundnut oil-based mayonnaise in the aspects of taste, colour and spreadability. In terms of aroma, both products were accepted at equal strength.

Table 4: Sensory evaluation for taste by 10 panelists

	Samples							
Panelists	542	501	544	502	541	503	543	504
1	1	5	5	4	1	3	2	5
2	2	6	3	6	3	6	4	5
3	2	5	4	6	4	6	4	5
4	1	3	1	2	3	2	2	1
5	4	7	2	4	2	3	4	7
6	2	3	5	2	5	4	4	3
7	3	4	5	5	3	4	4	4
8	3	4	4	5	1	3	5	2
9	1	1	3	5	5	6	5	4
10	3	4	5	5	1	3	2	6
Total	22	42	37	44	28	40	36	42

Table 5: Sensory evaluation for colour by 10 panelists

	Samples							
Panelists	542	501	544	502	541	503	543	504
1	3	4	5	5	2	5	3	5
2	4	5	4	6	4	6	5	6
3	3	4	4	6	4	5	5	4
4	1	3	2	2	3	3	4	1
5	3	4	3	6	4	1	5	6
6	3	2	5	6	3	5	5	3
7	3	5	5	6	3	5	5	3
8	4	2	4	6	2	5	4	4
9	3	2	4	6	5	5	5	6
10	3	5	4	6	1	5	3	6
Total	30	36	40	55	31	45	44	44

Table 6: Sensory evaluation for aroma by 10 panelists

	Samples							
Panelists	542	501	544	502	541	503	543	504
1	2	5	4	4	2	4	2	6
2	5	6	3	4	3	5	3	6
3	2	5	3	6	2	6	4	5
4	1	5	2	2	5	5	2	2
5	4	4	2	2	5	5	2	2
6	4	1	4	2	3	3	3	4
7	3	5	4	6	5	4	3	5
8	3	2	5	4	1	6	2	3
9	2	2	5	5	4	5	5	5
10	3	5	4	6	1	5	2	6
Total	29	40	36	41	31	48	28	44

Table 7: Sensory evaluation for spreadability by 10 panelists

	Samples							
Panelists	542	501	544	502	541	503	543	504
1	5	3	5	5	5	4	4	6
2	3	5	3	5	2	3	2	4
3	2	5	4	5	3	5	5	6
4	1	5	3	2	2	5	4	3
5	5	4	4	3	4	1	4	5
6	1	2	3	4	4	5	2	2
7	5	4	4	5	5	5	5	6
8	4	1	4	5	4	3	1	2
9	5	4	2	5	5	5	4	4
10	3	5	4	5	1	3	2	6
Total	34	38	36	44	35	39	33	44

Table 8: Total scores for groundnut oil and soya oil mayonnaise acceptance

Mayonnaise sample	Taste	Colour	Aroma	Spreadability
Groundnut oil-based	132	142	148	146
Soya oil-based	159	183	149	157

CONCLUSION

Mayonnaise can be prepared from groundnut oil and soya oil. Mayonnaise products from soya oil were observed to be more stable and accepted. The taste and spreadability of soya oil-based mayonnaise were observed to be more accepted by trained panelists. The groundnut oil-based mayonnaise was observed to be less stable due to its winterization requirement. However, when subjected to sensory evaluation it was noticed that groundnut oil-based mayonnaise gave an aroma that could be equally accepted as the soya oil-based mayonnaise. It was then concluded that mayonnaise can be successfully produced from groundnut oil and soya oil to the extent that it will meet laid down standards and will be accepted.

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