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Characterization of Za'tar (thyme) mixture

Hanee M. Al-Dmoor

Department of Nutrition and Food Processing, Faculty of Agricultural Technology, Al-Balqa Applied University, Al-Salt, Jordan

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Correspondence:
Hanee M. Al-Dmoor, Department of Nutrition and Food Processing, Faculty of Agricultural Technology, Al-Balqa Applied University, Al-Salt, P.C. 19117, Jordan. Tel: +962 777461218; Fax: +962 53530469; E-mail: dmour@bau.edu.jo

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Abstract

Introduction Five formulae of Za'tar mixtures were analysed to determine the characterization and identify the quality factors of this food product. *Methods* The formulae were based on differing mixtures of ingredients which affect the characteristics and qualities of the product. *Results* The averages of moisture, ash, oil, protein, crude fibre and available carbohydrate percentage for the tested mixtures were 4.21, 9.15, 6.86, 11, 8.5 and 60.2, respectively. The extracted essential oil content in Za'tar mixtures ranged from 2.7% in *Jabali to* 2.01% in *Extra* Za'tar. Salt, acidity, insoluble ash in hydrochloric acid, gross energy and density values were of higher formulae, containing less than 25% of thyme and 3% sumac. The overall acceptability of the Za'tar mixture showed *Super and Jabali* Za'tar mixtures which are high in thyme, sesame, sumac that are more preferred by the consumers. The overall acceptability as well as preference sensory tests correlated positively ($P < 0.005$) with both thyme and sumac which are the major ingredients in Za'tar mixtures. In contrast, all of the other components in the Za'tar mixture were negatively correlated ($P < 0.005$) with the overall panellist acceptability and preference. *Conclusions* Ingredients, proximate analysis, gross energy, insoluble acid ash, essential oil content, acidity, density, microscopic test and sensory properties can be used to measure the quality of this food product.

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Introduction

Za'tar (Za'atar or Zathar) mixture is a traditional food product in the Middle East, and is composed of dried thyme, toasted sesame seeds, sumac, salt, olive **oil**, toasted wheat, toasted chickpeas, citric acid, cumin and other suitable spices. Za'tar refers to any of the various herbs which comprise the mint family, including marjoram, oregano and thyme. The mixture is popular and usually consumed in different ways, such as eaten with bread and olive oil, spread on a dough base known as the *manakish*, sprinkled on *labneh* and used as spice in eggs, meats and vegetable meals. There is a belief that the consumption of Za'tar mixture every morning makes for an alert mind and strong body. For these reasons, children are encouraged to eat a Za'tar sandwich for breakfast before going to school and exams.

Za'tar mixture is thought to be a functional food product due to the physical and chemical properties and the health benefits of the ingredients of mixture. Thyme, the main ingredient in the preparation of Za'tar mixture, is brownish-green in colour with crescent leaves. It has a fragrant, aromatic odour and a warm, pungent taste. Colour and flavour will vary with origin (Stahl-biskup, 1991). The vital ingredient in thyme is its essential oil (thymol) which is used in liqueurs and medicines. Thyme oil strengthens the nerves, and helps in memory and concentration; it also has an antiseptic effect, the ability to modify intestinal flora and improve appetite (Dob *et al.*, 2006; Hinneburg *et al.*, 2006). The volatile oil components of thyme have also shown to have antimicrobial activity against a host of different bacteria and fungi such as *Escherichia coli*, *Bacillus subtilis*, *Staphylococcus aureus*, *Shigella sonnei*, *Bacillus*

cereus, *Listeria monocytogenes* and *Pseudomonas aeruginosa* (Stahl-biskup, 1991; Soliman & Badeaa, 2002; Gutierrez *et al*., 2008). Thyme is an excellent source of iron, manganese and vitamin K. It is also a very good source of calcium and a good source of dietary fibre (Stahl-biskup, 1991). Sesame seeds are either simply dried or dried and toasted; they can be off-white, brownish, grey or black in colour. The seeds are rich in manganese, copper, calcium, vitamin B1 and vitamin E. They also contain lignans, including a unique content of sesamin, which are phytoestrogens with antioxidant properties (Wu, 2007; Jinyoung *et al*., 2008). Ground sumac, with a deep-red to purple colour, is added for a sour taste. Sumac spice is extracted from the berries of a bush that grows wild in the Mediterranean region, especially southern Italy and parts of the Middle East, and is not the same as the poisonous sumac (Sierra, 2008). Traditionally, sumac is used as an astringent agent with promising inhibitory effects on foodborne bacteria and could be considered as natural food preservatives; it also has antioxidant property (Hinneburg *et al*., 2006; Fazeli *et al*., 2007; Kosar *et al*., 2007). Other ingredients in the mixture include olive oil added in a small amount for appearance factor, toasted wheat or chickpeas as bulking and for weight of the products, salt for taste, citric acid for a sour taste, and other herbs for flavours and desirable tastes. There is a lack of information about this food product; this study aimed to spotlight its possible role as a functional food product. There is a need for more research and to standardize the production and handling of Za'tar mixtures. A study of the effect of ingredients on the characteristics of Za'tar mixtures is needed to help identify quality factors which can be used as a reference for establishing standardized mixtures of Za'tar.

Materials and methods

Formula

A simple questionnaire was distributed to 25 Za'tar mixture producers in Jordan to receive the formula and the percentage of each ingredient in the mixture.

Sampling

Five local Za'tar mixtures, *Extra* Za'tar, *Super* Za'tar, *Za'tar Jabali, Za'tar Khososi* and *Normal* Za'tar, were prepared by a researcher in cooperation with three producers in Jordan. Each one was mixed, subdivided into five bags, named and kept in a freezer in closed container until the project is finished.

Approximate analysis

Moisture was determined using vacuum oven method at 60 °C according to AOAC method no. 925 08 (AOAC, 2000). *Ash* was measured using the muffle furnace at 550 °C according to AOAC method No.923 02. *Oil* was determined using soxhlet extraction according to AOAC method No.960 39. *Protein* content was calculated after measured nitrogen using Kjeldahl method (protein % = 6.25 N %) according to AOAC method No.979 09. *Crude fibre* was determined according to AOAC method no. 962.09. *Available carbohydrates* content was calculated according to the difference method (100 – Moisture % + Ash % + Fat % + Protein % + Fibre %).

Other quality factors

The *essential oil* content in Za'tar mixture samples was extracted using a steam distillation unit. *Salt* (NaCl) percentage was determined according to AOAC method no. 925.55. *Acidity* was measured as citric acid by titration using NaOH. *Insoluble ash in hydrochloric acid* was measured according to AOAC method no. 972.15B. Gross energy was determined using a bomb calorimeter. *Adulteration* of Za'tar mixture was obtained using *density* (weight per unit volume) and *microscopic examination* (40×) to detect other plant leaves.

Sensory evaluation

An untrained panel of 76 persons evaluated the overall acceptability of the five Za'tar mixture samples using both a *hedonic scale* and *preference test* as described by (Lawless & Hildegarde, 1999). The scores were based on a nine-point hedonic scale, where nine represented Like extremely and 1 Dislike extremely. Preference tests of the five types of Za'tar mixture evaluated the overall acceptability of the Za'tar mixture samples.

Statistical analysis

Data obtained were expressed as the mean of three replicates ± one standard deviation. A completely randomized design was applied using the GLM procedure and correlations determined using the SAS program (SAS Institute, 2008). The statistical significance of differences was assessed using analysis of variance. Significance was declared at $P < 0.05$ (Steel *et al*., 1996).

Results and discussion

The formula and the average percentage of each ingredient of the five locally named Za'tar mixtures, *Jabali*, *Super*,

Table 1 Formula and the percentage of ingredients of Za'tar mixtures

	Jabali	Super	Khososi	Normal	Extra
Ingredients[1]					
Thyme %	$48^{c} \pm 1.5^{2}$	$43^{b,c} \pm 1.5$	$38^{b} \pm 1.4$	$25^{a} \pm 1.6$	$24^{a} \pm 1.6$
Sesame %	$30^{a} \pm 2$	$30^{a} \pm 1.6$	$30^{a} \pm 1.2$	$28^{a} \pm 1.3$	$29^{a} \pm 1.3$
Sumac %	$7^{a} \pm 0.31$	$8^{a} \pm 0.41$	$7^{a} \pm 0.2$	$3.1^{b} \pm 0.16$	$2.4^{b} \pm 0.12$
Toasted wheat or chickpeas %	$8^{b} \pm 1$	$11^{a} \pm 2$	$16^{b} \pm 1.1$	$26^{c} \pm 3.2$	$24^{c} \pm 3.4$
Other spices %	$3^{a} \pm 0.6$	$4^{a} \pm 1.5$	$3^{a} \pm 1.2$	$10^{b} \pm 3.1$	$8^{b} \pm 2.2$
Salt %	$1.9^{a} \pm 0.8$	$1.8^{a} \pm 0.5$	$2.3^{a} \pm 0.3$	$4.1^{b} \pm 1$	$4.2^{b} \pm 1.5$
Citric acid %	$0.18^{a} \pm 0.04$	$0.17^{a} \pm 0.05$	$0.2^{a} \pm 0.06$	$1.7^{b} \pm 0.06$	$1.7^{b} \pm 0.07$
Olive oil %	2 ± 0.20^{a}	2 ± 0.2^{a}	3 ± 0.34^{a}	3 ± 0.15^{a}	3 ± 0.16^{a}

[1]Average of 25 questionnaires.
[2]Standard deviation values.
Means within rows with different letters are significantly different according to LSD at $P \leq 0.05$.

Table 2 Approximate analysis of Za'tar mixtures

	Jabali	Super	Khososi	Normal	Extra
Analysis[1]					
Moisture %	$3.9^{a} \pm 0.4^{2}$	$3.93^{a} \pm 0.2$	$3.66^{a} \pm 0.22$	$4.86^{b} \pm 0.3$	$4.75^{b} \pm 0.2$
Ash %	$8.58^{a} \pm 1.5$	$8.49^{a} \pm 1.3$	$7.83^{a} \pm 1.5$	$10.49^{b} \pm 2$	$10.35^{b} \pm 1.8$
Oil %	$6.3^{a} \pm 0.5$	$5.8^{a} \pm 0.8$	$7.4^{b} \pm 0.5$	$7.6^{b} \pm 0.4$	$7.2^{b} \pm 0.6$
Protein %	$10.2^{a} \pm 1$	$9.8^{a} \pm 1.5$	$11.1^{b} \pm 0.8$	$12.7^{c} \pm 1.8$	$11.4^{b} \pm 1.1$
Crude fibre %	$8.8^{c} \pm 1.1$	$8.63^{b,c} \pm 0.8$	$8.45^{a,b} \pm 1.2$	$8.4^{a} \pm 1.5$	$8.21^{a} \pm 1.3$
Carbohydrates %	$62.22^{b} \pm 1.5$	$63.35^{b} \pm 1.4$	$61.57^{b} \pm 1.2$	$55.95^{a} \pm 1.7$	$58.09^{a} \pm 1.9$

[1]Average of three replicates.
[2]Standard deviation values.
Means within rows with different letters are significantly different according to LSD at $P \leq 0.05$.

Khososi, Normal and *Extra*, are shown in Table 1. The level of thyme present ranged from 24% in *Extra* to 48% for *Jabali*. The results showed no significant difference between *Normal* and *Extra* mixtures, with significant differences to the other Za'tar mixtures that contain relatively high levels of thyme. Toasted sesame was found to be the second most important ingredient of the mixtures, with the content ranging from 28% to 30%. Sumac used in *Jabali, Super* and *Khososi* mixtures were 7%, 8% and 7%, respectively, while its content in *Normal* was 3.1% and in *Extra* was 2.4%. In contrast with thyme, sesame and sumac, toasted wheat or chickpeas were used in large amounts in the production of *Normal* (26%) *and Extra* (24%), compared with the other Za'tar mixtures. The same trend was also found for other spices, salt and citric acid utilization, for example, 9%, 4.2% and 1.8%, respectively, for *Extra* and 4%, 1.8% and 0.17% for the *Super* formula. The olive oil content ranged between 2% and 3% for all mixtures.

The high-quality Za'tar mixtures were mainly based on thyme, sesame and sumac, while the lower-quality products used other food ingredients such as toasted wheat or chickpeas, other spices, salt, and citric acid to replace thyme, sesame and sumac because of the higher costs of the latter ingredients. Toasted wheat or chickpeas were used as bulking agents to promote browning and influence taste. They also raised the bulk weight and diluted the warm and pungent taste of thyme. Salt was used for taste and to raise the bulk weight of the mixtures while citric acid was used as an inexpensive substitute for sumac to deliver the sour taste for the mixtures. Olive oil levels in *Normal* and *Extra* formula were high compared with the other formulae. There may have been some absorption of the oil by toasted wheat or chickpea additions.

The proximate compositions of the Za'tar mixtures are shown in Table 2. Moisture content in formulae ranged between 3.66% in *Khososi* to 4.86% in *Normal* Za'tar mixture. No significant difference was found between *Jabali*, *Super* and *Khososi* which were statistically different with *Normal* and *Extra* formula. The *Khososi* mixture had the lowest ash content (7.83%) with no significant difference to *Jabali* and *Super* mixtures, but the latter were statistically different to the *Normal* and *Extra* formulae which contained 10.49% and 10.35%, respectively. No significant difference was found between *Khososi*, *Normal* and *Extra* for the oil

Table 3 Other quality factors of Za'tar mixtures

	Jabali	Super	Khososi	Normal	Extra
Quality factor[1]					
Gross energy (kcal per 100 g)	$344.8^{a} \pm 6^{2}$	$331.2^{a} \pm 4$	$348.0^{a} \pm 2$	$402.4^{b} \pm 4$	$425.7^{b} \pm 5$
Insoluble acid ash %	$0.0114^{a} \pm 0.001$	$0.0143^{a} \pm 0.002$	$0.0112^{a} \pm 0.009$	$0.0222^{b} \pm 0.007$	$0.0296^{b} \pm 0.01$
Total acidity%	$1.03^{a} \pm 0.06$	$1.17^{a} \pm 0.03$	$1.15^{a} \pm 0.02$	$1.51^{b} \pm 0.01$	$1.60^{b} \pm 0.04$
Essential oil (mL per 100g)	$2.7^{b} \pm 0.16$	$2.7^{b} \pm 0.24$	$2.6^{b} \pm 0.21$	$2.1^{a} \pm 0.14$	$2.01^{a} \pm 0.15$
Salt %	$2.04^{a} \pm 0.6$	$2.27^{a} \pm 0.8$	$2.56^{a} \pm 0.6$	$4.74^{b} \pm 1.3$	$4.45^{b} \pm 0.8$
Density	$0.5126^{a} \pm 0.08$	$0.5011^{a} \pm 0.1$	$0.5112^{a} \pm 0.12$	$0.5634^{b} \pm 0.23$	$0.56^{b} \pm 0.12$

[1]Average of average of three replicates.
[2]Standard deviation values.
Means within rows with different letters are significantly different according to LSD at $P \leq 0.05$.

content, while *Jabali* and *Super* contained 6.3% and 5.8%, respectively. The lowest protein percentage was found in *Super* (9.8%) followed by Jabali and they were significantly different to other Za'tar mixtures which contained more than 11% protein. The crude fibre content in Za'tar mixtures ranged from 8.21% in *Extra* to 8.8% in the *Jabali* formula. The table shows that *Normal* and *Extra* contained lower amounts of available carbohydrate compared with *Jabali*, *Super* and *Khososi* which were statistically different.

These combinations of plant food ingredients are rich in phytoestrogens with antioxidant property and antibacterial activity. They may have anti-cancer properties and supply many nutrients. These characteristics mean that Za'tar mixtures can be significant to our diet. The percentage of moisture, ash, oil, protein, fibre and carbohydrates differ depending on the ingredients used in the formulae. Low moisture, acidity, salt content, along with functional components in thyme, sesame and sumac (antioxidants and antimicrobials), increase the healthiness of the products and suggest that it could be classified as a functional food product.

In general the results showed that the compositions of Za'tar mixture enhanced the keeping quality during the shelf-life of the product.

Gross energy (kcal per 100 g) values of Za'tar mixtures are shown in Table 3. Both *Normal* and *Extra* formulae have higher values than the other tested samples which were around 440 kcal. Also, insoluble acidic ash, total acidity, salt and bulk density (weight per unit of volume) values in *Normal* and *Extra* formulae were found to be higher than in Jabali, *Super* and *Khososi* which were statistically different to the *Normal* and *Extra* formulae. The *Super* mixture had the lowest insoluble acidic ash content (0.0112%) with no significant difference from *Jabali* and *Khososi* mixtures which were statistically different to *N*ormal and *Extra* formulae. Acid concentration, as citric acid, ranged from 1.03% in *Jabali* to 1.6% in *Extra*. The salt content was lowest in *Jabali* (2.04%) while it was more than 4.45% in *Extra* and *Normal* mixtures. The same trend was found for the density values of Za'tar mixtures. The extracted essential oil content of Za'tar mixtures ranged from 2.01% in *Extra* to 2.7% in *Super* and *Jabali* formulae.

Table 4 The overall acceptability and percentage of preferring Za'tar mixtures

	Overall acceptability Hedonic scale test[1,2]	Preference test[3] % of preferring
Jabali	7.6^{c}	26^{c}
Super	8.1^{c}	38^{d}
Khososi	6.8^{b}	19^{b}
Normal	6.1^{a}	10^{a}
Extra	6.2^{a}	7^{a}

[1]A nine-point hedonic scale.
[2]Values represented means ($n = 76$).
[3]Percentage of frequency of preferred mixture by 76 persons.
Means within rows with different letters are significantly different according to LSD at $P \leq 0.05$.

Gross energy values may vary as the result of using higher levels of toasted wheat, toasted chickpeas and olive oil. Additions of salt and other spices increased the ash content in the mixtures while the essential oil content increased by using more thyme, sesame and sumac. Acidity was affected by the addition of citric acid in place of sumac to give a sour taste to the product.

Measuring the bulk density could be a good quality factor for determining the use of salt, citric acid, other spices, wheat and chickpeas, instead of thyme, sesame and sumac in Za'tar mixtures because the said ingredients increase weight per volume. Adulteration in Za'tar mixture using other plant leaves was determined using microscopic test to distinguish between thyme leaves and other plant leaves based on their morphological characters.

The results of the sensory evaluation for the overall acceptability of the Za'tar mixture are shown in Table 4. In general, the hedonic scale scores showed that all of the tested samples were rated as like slightly or higher. *Normal* Za'tar

Table 5 The correlation between the sensory evaluation (overall acceptability and preference test) with Za'tar mixture ingredients

	Ingredients used in Za'tar mixture (%)							
	Thyme	Sesame	Sumac	Toasted wheat or chickpeas	Other spices	Salt	Citric acid	Olive oil
Overall acceptability	0.90*	0.43^{NS}	0.89*	–0.90*	–0.68*	–0.78*	–0.85*	–0.87*
Preference test	0.85*	0.40^{NS}	0.91*	–0.84*	–0.64*	–0.78*	–0.84*	–0.82*

*P value < 0.005.
NS, not significant.

and *Extra* Za'tar mixtures had *lowe*r and statistically significant scores than the others. *Super* Za'tar mixture had the best rating (with a score of 8.1 out of 9).

The Za'tar *Jabali* mixture had the second highest score for acceptance (7.6), followed by the Za'tar *Khososi* mixture (6.8). The preference test results confirmed the sensory evaluation of the overall acceptability of the Za'tar mixture in the hedonic scale test. *Super* Za'tar mixture had the highest preference percentage (38%) for the panellists and was statistically significant to the other formulae. This result may be due to the use of high percentage of thyme and sumac in the mixture. The Za'tar *Jabali* mixture had the second rated preference (26%) followed by the Za'tar *Khososi* mixture, *Normal* Za'tar and *Extra* Za'tar mixture with preferences of 19%, 10% and 7%, respectively. No significant difference was observed between *Normal* Za'tar and *Extra* Za'tar mixtures.

Table 5 shows the correlation for the overall acceptability and the preference percentage of the Za'tar mixtures with the percentage of ingredients in the mixture. The results show that the overall acceptability as well as Za'tar preference correlate positively ($P < 0.005$) with both thyme and sumac levels, the major ingredients of Za'tar mixtures. On the other hand, all the other components in the Za'tar mixtures were negatively correlated ($P < 0.005$) with the overall panellist acceptability and preference. Although acceptability and preference correlate with that amount of added sesame to the mixture, this correlation was not significant. The correlation between overall acceptability and the percentage of preferring the Za'tar mixture results is a reflection of the high quality of Za'tar mixtures (with high levels of thyme, sesame and sumac) compared with the low-quality and low-priced mixtures used – in part, other food ingredients such as toasted wheat or chickpeas, other spices, salt, and citric acid replaced the high-cost ingredients: thyme, sesame and sumac.

Conclusions

After carrying out this study, two trends in the production of Za'tar mixtures were observed; one is the manufacture of high-quality mixtures based on the thyme, sesame and sumac contents, and the other is the use of lower-cost substitutes such as toasted wheat or chickpeas, other spices, salt, and citric acid.

The percentages of moisture, ash, oil, protein, fibre carbohydrates differ depending on the ingredients used in formulae. In general, the results have shown that the compositions of Za'tar mixtures were enhancing the keeping quality during the shelf-life of the product. Low in moisture, acidity and salt content, and with antioxidant and antimicrobial components in thyme, sesame and sumac, this product can be considered to be a healthy food or be classified as a functional food product. Many other quality factors of Za'tar mixtures can determine the quality of Za'tar mixtures including; gross energy, insoluble acid ash, essential oil content, acidity, density, microscopic examination and sensory evaluation.

It is recommended that this food product be studied further to examine compounds that have potential beneficial effects, for example, thyme antioxidants (flavonoids such as apigenin, naringenin, luteolin and thymonin), *Origanum* (antioxidants), sesame (polyunsaturated fatty acids) and so on.

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