Proximate, Total Calorific Values and Organoleptic Qualities of Milk Chocolate incorporated with different Spices

Abstract

An innovative spicy chocolate was developed in this study by partial replacement of cocoa nibs with different selected spice powders of : Ginger (G_{11}), Garlic (G_{12}), Clove (C_{13}), Cinnamon, (C_{14}), Turmeric (T_{15}), *Aframomum danielli*, (A_{16}), *Aframomum melegueta*, (A_{17}), Thyme (T_{18}), Black Pepper (B_{19}) and Clappertonia (C_{20}) . Milk chocolate without spices (C_{10}) served as Control. The proximate chemical qualities of samples were carried out using standard methods. The Total Calorific values (TCV) was determined using the Atwater factors (physiological fuel values) of 4kcal, 4kcal and 9kcal per gram of carbohydrate, protein and fat respectively. The sensory evaluation was carried out by panel of tasters consisting of 13 males and 18 female's staff of the Cocoa Research Institute of Nigeria who were used to consuming chocolates.

The result showed significant differences in the proximate chemical compositions of the chocolates ($p<0.05$). Apart from black pepper with a significantly lower protein and ash contents than the control chocolate, all the other spices significantly caused an increase in percentage protein and ash in milk chocolates. The trend of protein increase is T18 > G11 > T15 > C20 =A17 > A16 > C14 > C13 > G12 > C10 > B19 > respectively.. The range of values obtained for the proximate compositions were: :Protein (6.34 - 7.44); Fat (31.53 - 34.42), Ash, (2.27 -2.81), Moisture Content (5.06 - 5.86). Crude fibre (2.35 -2.68%. and Carbohydrate (47.83 -51.63) respectively. The Total Calorific Value (TCV) also showed significant differences among all the samples at $p<0.05$ with the TCV of the control chocolate being the highest. The addition of spices contributed to acceptable tastes, aroma, flavor and general acceptability of milk chocolates.

In Conclusion, this study showed that the incorporation of Spices in chocolate increased the protein and ash content of milk chocolate, the organoleptic acceptance while reducing the TCV values This is a desirable findings in view of the fear of high calorific values of Milk Chocolate which may predispose consumers to Obesity when consumed.in large quantities.

Key words: Spice, Chocolate, Proximate, Organoleptic qualities.

Introduction

Considerable interest has developed recently on the preservative effects of spices in grains and legumes because of the presence of compounds that can control the growth of spoilage microorganisms (bacteria and moulds) in them. Some of the spices have also been used as antioxidants capable of reducing oxygen radicals which predisposes food products to oxidative deterioration which is consequential to development of off flavor, off-odour and changes in the taste of foods and its palatability. Spices have been used for many years because of flavouring agents in foods and other culinary activities.. Using spices in foods make it a significant additives used in foods and considered as Generally Regarded as Safe for consumption (GRAS family), as recommended by USFDA. This has also necessitated their use in different food products such as Dairy, confectionery, juices, meats, fats and oil. Recent advances in food safety has condemned the use of chemical additives for food preservation because of the resultant carcinogenic and mutagenic effects it imparted on humans. However, the utilization of spices in chocolate was reported by Fatima and Ali, 2014 who developed a functional chocolate with some spices and lemon peels powder and optimized tier uses applying the response surface Methodology. Aroyeun, 2009, formulated a milk chocolate containing *Aframmomum danielli* and reported the possibility of using *Aframomum danielli* in chocolate. Chocolate is a highly nutritious energy source with a fast metabolism and good digestibility. The presence of cocoa, milk, and sugar in its composition can be the warranty of an appropriate ingestion of proteins, carbohydrate, , fats, minerals and vitamins (Campes and Benedet, 1994, but unfortunately, it is seldom consumed in Nigeria owing to the general belief that its consumption is associated with some cardiovascular diseases. Despite this, chocolate is an example of most widely relished confectionery product because of its health benefits. Making chocolate to be more functional involved the addition so many other non chocolate materials like fruits, vegetables, legumes and some spices such as Aniseed, Ginger, lemon peels, are known to have some nutritional benefits or some antimicrobial or antioxidant properties (Fatim and Ali, 2014). A detailed literature review has shown that there is a paucity of information on the characteristics proximate composition due to the addition of spices., the organoleptic values and their total calorific values and this formed the background of this study and on which the objetives of this study was based. ...

Materials and Methods

Aframomum danilli, *Aframomum melegueta*, Cinnamon, Black pepper, Thyme, Ginger, Cloves, *Clappertonia* and Turmeric powders were obtained from the general local Market in Ibadan Metropolis. Other ingredients like Milk powder, Sugar, Lecithin and Cocoa butter were purchased from the Agbeni Market, Ibadan, Nigeria. Spices were sorted, dried at ambient temperature and ground into a fine powder and preserved in a sealed polythene bag to avoid moisture absorption prior to its utilization in the chocolate production.

Chocolate bar production

The methods of Aroyeun and Jayeola, 2016 was used for the production of chocolate with few modification . Cocoa pods were harvested at the matured stage when the pods had turned yellowish or brownish on the outside. The harvested pods were taken to the fermentary where pods were broken to extract the wet beans from the pods in preparation for cocoa bean fermentation using tray fermentation method for 5 days. After the expiration of fermentation, the cocoa beans were dried under the sun for 7-8days to a moisture content of $<6\%$. The dried cocoa beans were later transported to the chocolate laboratory for roasting in Gallenkamp oven at temperature of $120^{O}C$-$123^{O}C$ for 1 hour, air-cooled, shelled and winnowed manually to separate shells from nibs The essence of roasting was to generate a volatile flavor characteristics for the chocolate and soften the testa for its easy removal . . The roasted beans were later deshelled manually and winnowed to obtain the cocoa nibs.. The cocoa nibs were weighed (approximately 5kg and ground into a liquor in a laboratory grinder. At the point of Grinding, the spices were added as a partial replacement of the cocoa nibs at a w/w level. After grinding the cocoa nibs into liquor, cocoa butter, lecithin, sugar, milk were added in that order, the chocolate paste was then refined in three-roller refining machine followed by Conching with cocoa butter in a conching machine at $65^{O}C$-$70^{O}C$ for 5 hours, the chocolate paste was manually tempered to obtain a stable cocoa butter crystals within the chocolate. The chocolate was then moulded, wrapped and stored in refrigerator (See fig 1).

The flow chart of chocolate processing is shown below in Fig 1 and the Recipe for the production of chocolate was shown in table 1..

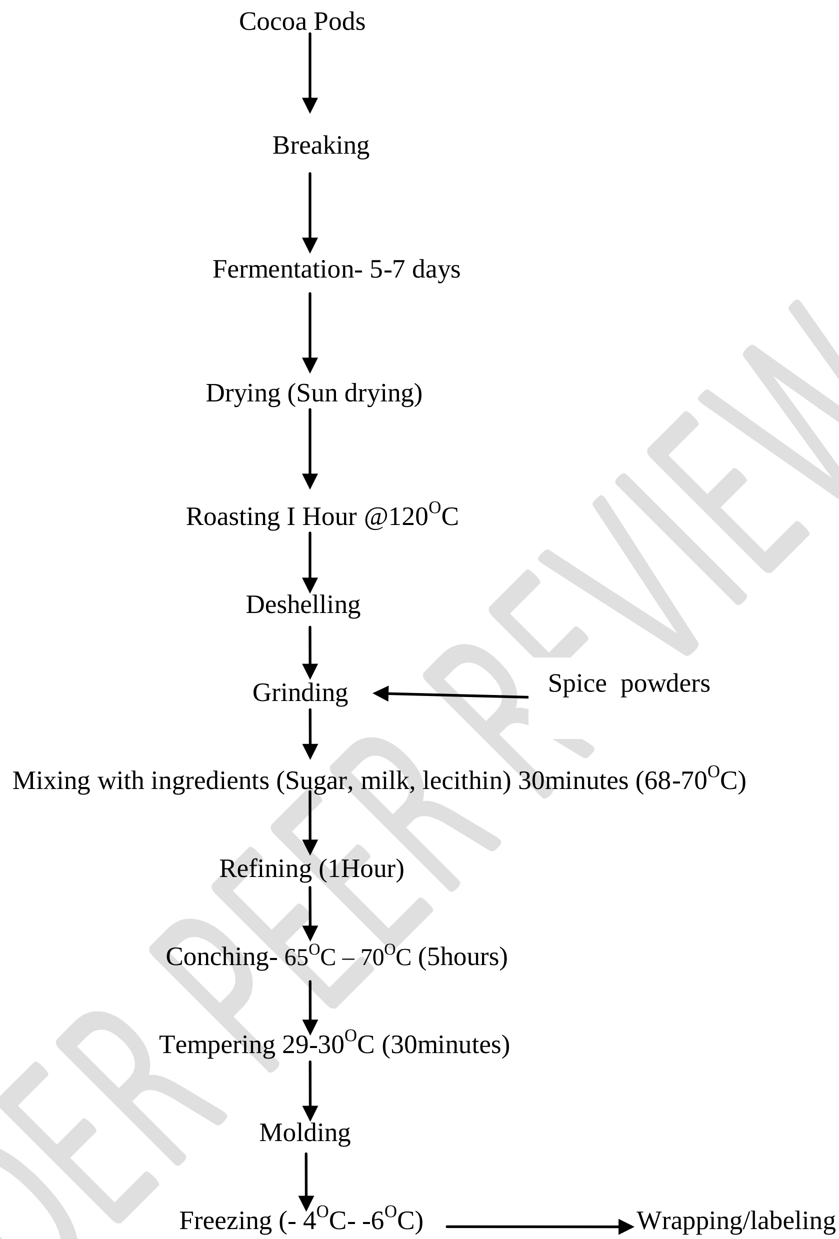

Fig 1. Flow Chart for Spicy chocolate Chocolate Production

Proximate analysis

Proximate analysis of all the chocolate samples were carried out according to AOAC 1996. Methods. Moisture was determined by the atmospheric oven method (100-102 °C for 16 h), until constant weight. Protein content was determined by the micro-Kjeldahl method, using a nitrogen conversion factor of 6.25. Crude fat was determined using the Soxhlet method with hexane as solvent*f* ash by ignition in a muffle furnace for 10minutes at 550 ^{O}C. The carbohydrate contents were obtained by difference. The Total Calorific values (TCV) was determined using the Atwater factors (physiological fuel values) of 4kcal, 4kcal and 9kcal per gram of carbohydrate, protein and fat content of the samples respectively. All the analyses were done in triplicate.

Sensory Analyses

Sensory analysis of chocolates

The chocolate tasting tests were done after 2-day storage at 4 °C in a refrigerator.. For this purpose, an - 11 differently coded samples of the spicy chocolates and the Control were presented to a 21-member sensory panelists who are regular eaters of chocolate and who had been previously selected from the staff and students on industrial attachment from different universities in Nigeria (Males= 13, Females=8). The global quality and the intensity of each attribute was evaluated simultaneously using a scale varying from 0 to 9 hedonic scale. . The sample codes used were : C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Turmeric, A16-*Aframomum danielli*, A17-*Aframomum melegueta*, T18—Thyme, B19---Black pepper, and C20--- Clappertonia, respectively. -

. The sensory analyses used by Aroyeun and Jayeola , 2016 was adopted. Determination of sensorial profile of all the chocolate samples were performed with a descriptive analysis of the ISO 13,299 in the Cocoa Research Institute of Nigeria tasting room. In this method, each taster was given an evaluation form for each of the chocolate samples. The form included four sensory attributes of taste, odour, Aroma, Flavour and overall acceptability. Panelist were requested to assess the chocolate samples using a 9-point hedonic scales with 9-representing like extremely and 0 representing dislike extremely. The tasting was carried out in a well illuminated tasting room. Tasters were put in a tasting booth and separated from each other with a square plywood and were prevented from communicating with each other to avoid undue bias in sensory judgment during the tasting session.. Tasters were provided with water to rinse their mouth after a round of tasting .

Statistical Analyses

The statistical analyses of all the data collected were carried out with the XLSTAT (Microsoft) software version 19.02. 2017. Analyses of variance (ANOVA) were performed to indicate the significant differences among the sensory attributes in the chocolate samples Means were separated using Duncan’s Multiple Range Test and significance were determined at $p<0.05$

Results and Discussion

The proximate composition of the chocolate samples in this study is shown in table 2. From the results obtained, highly significant differences were recorded for all the proximate chemical compositions of the chocolate samples. Since the amount of spices added to the milk chocolate was the same , it is easy to detect a significant contribution of each spice to the overall chemical and sensorial properties of the made spice supplemented chocolates.. According to table 2, the protein content ranged between 6.34-7.44% while the percentage fat content of the chocolate samples fell between 31.83%-34.43. The percentage crude fibre ranged between 2.35 -2.68%. The values obtained for the Ash contents ranged between 2.21-2.81%. Apart from samples C14 and G11, all the remaining chocolates contained significantly reduced carbohydrate contents which is a desirable results since increase in carbohydrate values in food samples causes an increase in sugar contents which may be a worry to the diabetes and those who have issue bothering on sugar and health. The control chocolate contained about 48.8% in carbohydrate when compared to other samples while the chocolate with *Aframomum danielli*, (A16), *A.* melegieta (A17), cloves (C13), Clappertonia (C20), Garlic (G12), Turmeric (T15), Thyme (T18), significantly resulted in reduction of carbohydrate which consequently resulted in reduction of the Total calorific values of the Milk chocolates.. The moisture contents of the chocolate containing spices were significantly different from the control sample and ranged between 5.06% and 5.86%. These values were far higher than the value reported by Aroyeun and Jayeola, 2016 who used green tea to supplement milk chocolate in green tea chocolate production. The values reported by Aroyeun and Jayeola ranged between 1.15-2.15%. There are two possibilities for the variation in values with this current study: i. The initial moisture content of the supplementing spice and the moisture pick up after the processing stage. Fatimah and Ali, 2014 also reported a similar value to Aroyeun and Jayeol (2016). One could probably assume that the moisture content of spices added must have contributed to the moisture of the spicy chocolate.. Differences in the moisture contents of other ingredients must have also contributed. According to Fatimah and Ali, 2014, chocolate moisture content must fall within 0.5 and 1.50% and above which the rheological parameters will be affected and consequently causing difficulty in chocolate flow properties because of sugar agglomeration leading to grittiness in the chocolate and also causes an increase in its viscosity and its yield value., Obatoye *et al*., 2014 also reported values of moisture content between 0.90-1.2 The authors opined that the reason for the low moisture contents obtained in their studies was due to the drying levels of all the different ingredients used in the formulation. The % protein obtained in this study was higher than the work of Akinwale, 2004, who reported a value of 5.25% for soya-fortified chocolate which was lower than the value obtained in black pepper chocolate with protein content of 6.34% in this study. Our findings was in compliance with the work of Fatimah and Ali, 2014 who reported an increase in %protein as a result of addition of Cinnamon, Aniseed, ginger and lemon peels to their chocolates. Previous reports by Aroyeun and Jayeola, 2016 has showed an increase in %protein content in green tea chocolate with increasing levels of green tea in the formulation. This study however proved the possibility of improvement in %protein contents of chocolates with other additives. The % ash content as reported in this study varied significantly too. The ash contents ranged between 2.27 and 2.76, the values which were higher than the values reported by Obatoye *et al*, 2014 when cow milk and soya milk powders were used in the formulation of chocolate. The values obtained in this study predicted the possibility of mineral accumulation in chocolate containing spices. Although the values of the Ash contents of the spicy chocolate samples and the control (C10) fell within the regulated levels of 2.4% , it was evident from our data that some spices resulted in a significantly higher value than the 2.4% regulatory values for chocolate. This value is different from the values reported by Rubia *et al*, 2011 who reported varying ash contents for different chocolate brands purchased in Brazilian Markets. Kharat and Deshpande, 2017 also reported a lower value of Ash in their probiotic chocolate but a similar percentage value in protein to our own findings. .The percentage fat contents varied significantly according to the type of spice used. However, the different chocolate samples and the control chocolate ,C10, contained significantly different percentage levels of fat with a range of values between 31.53 and 34.43. The addition of spices and the increase in fat contents of chocolate may be due to the oil composition of the spices coupled with the cocoa butter contents. Most spices have been reported to contain essential oils and as such can contribute to the stability of the chocolate samples The carbohydrate contents of chocolate obtained in this study fell between 47.83 and 51.63 which is not in tandem with the reports of ICCO, 2001, which confirmed that fat contents of chocolate was 2.6%. Other reports have indicated that the Carbohydrates of chocolate whether dark, milk or white chocolate could be more than this value (Ezikaimure, 2010, Obatoye *et al*, 2014, Aroyeun, 2016, Rubia *et al*, 2017). The crude fibre of the chocolate varied accordingly and with significant differences. The range of values for crude fibre fell within reported values and it is between 2.35 an0 2.68. The values obtained were far higher than the one reported by Obatoye et al., 2014 who reported a range of values of 0.86 to 0.98. It is obvious that the chocolate containing spices can have a health benefit and can serve as a snack that can enhance the health of gastrointestinal tract as it can contribute to easy bowel However, the values were t within the regulated c values for a standard chocolate..

Table 2: Proximate Chemical Comn of chocolate supplemented with different Spices

Chocolate samples	% Protein	% Fat	% CF	% Ash	% M.C	% CHO
A17	7.23	34.38	2.35	2.59	5.6	48.5
A16	7.03	34.43	2.41	2.65	5.65	47.83
B19	6.34	32.27	2.43	2.27	5.06	51.63
C10	6.83	33.58	2.68	2.36	5.74	48.81
C13	6.92	33.63	2.50	2.44	5.86	48.65
C20	7.23	33.83	2.54	2.57	5.59	48.24
G11	7.34	31.53	2.60	2.81	5.84	49.88
G12	7.01	33.1	2.57	2.76	5.79	48.77
T15	7.33	34.17	2.42	2.47	5.68	47.93
T18	7.44	34.25	2.38	2.43	5.65	47.85
C14	7.11	33.26	2.47	2.51	5.62	49.03

Legends: C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Tumeric, A16-*Aframomum danielli*, A17-*Aframomum melegueta*, T18—Thyme, B19---Black pepper, C20--- Clappertonia, CHO-Carbohydrate; M.C. –Moisture content --

Table 3: Sensory Analyses of Spicy Chocolate

Chocolate samples	Taste	Aroma	Texture	Colour	Overall Acceptability
G11	5.75 ± 1.916	6.2 ± 2.093	6.75 ± 1.070	7.10 ± 1.190	6.45 ± 1.40
G12	5.15 3± 2.25	5.75 ± 1.552`	5.85 ± 1.349	7.35 ± 0.990	5.4 ± 2.30
C13	3.65 ± 1.814	4.75 ± 2.221	5.95 ± 1.349	6.65 ± 1.630	4.4 ± 2.14
C14	5.5 ± 2.013	5.35 ± 2.007	6.65 ± 1.270	7.15 ± 1.840	6.2 ± 1.82
T15	4.25 ± 2.150	4.55 ± 2.080	4.75 ± 2.074	3.7 ± 1.840	4.3 ± 2.05
A16	4.95 ± 2.164	6.7 ± 1.892	5.7 ± 1.780	7.25 ± 1.41	6.00 ± 1.49
A17	6.45 ± 1.538	6.25 ± 1.410	5.5 ± 1.431	7.3 ± 1.170	6.25 ± 1.37
T18	4.75 ± 2.074	5.20 ± 2.000	5.15 ± 8.140	6.95 ± 1.54	5.2 ± 2.12
B19	5.65 ± 2.183	5.60 ± 1.875	6.45 ± 1.960	6.70 ± 1.53	5.65 ± 2.06
C20	2.80 ± 1.399	3.75 ± 2.100	5.05 ± 2.039	7.1 ± 2.100	2.063.55 ±
C10	8.4 ± 0.503	7.7 ± 0.660	7.65 ± 0.750	7.3 ± 0.920	8.1 ± 0.45

Legends: C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Tumeric, A16-*Aframomum danielli*, A17-*Aframomum melegueta*, T18—Thyme, B19---Black pepper, C20--- Clappertonia

Table 4: Total Calorific value of Chocolates containing spices and the Control

Chocolate	TCV (Kcal100/g)
A17	532.34
A16	529.31
B19	522.31
C10	524.78
C13	524.15
C20	244.74
G11	250.28
G12	246.25
T15	242.82
T18	242.58
C14	246.79

Legends: C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Turmeric, A16-*Aframomum danielli*, A17-*Aframomum melegueta*, T18—Thyme, B19---Black pepper, C20--- *Clappertonia*

Sensory characteristics of chocolates

Table 3 shows the sensory profiles of chocolates produced with the addition of different spices. Taste, Aroma, Texture, Colour and Overall Acceptability were analyzed. Table 3 describes superiority of the control chocolates to other spice supplemented samples in all the sensory profiles evaluated. The control chocolates (C10) are described to have high scores such as 8.4, in taste, 7.7 in Aroma, 7.65 in Texture, 7.3 in Color and 8.1 in general acceptability for all the desirable notes in intensity of those attributes respectively. Chocolates supplemented with spices have significant differences at $p<0.05$ in all the attributes evaluated during the organoleptic assessments. A lot of factors might have contributed to this. It could be due to their differences in physical, chemical, biochemical, agronomical and their physiological properties. Of all the spice supplemented chocolates, the sample coded A17 (*Aframomum melegueta* seemed to be closer to the control sample although significantly different in other properties but not in the attributes of Taste, and Aroma with scores of 6.45 and 7.3 respectively.

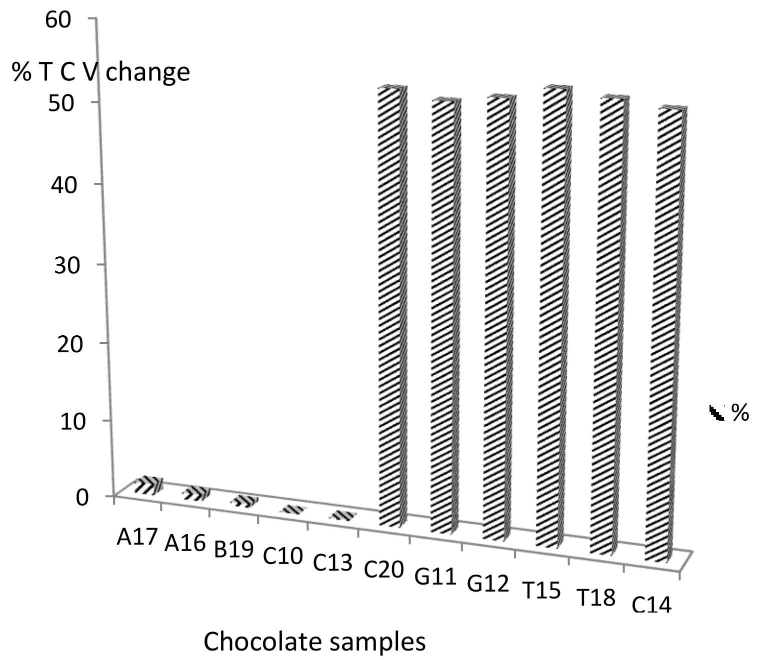

Figure 2 : Changes in Total Calorific Value as a result of spice otal

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Table 4 and Figure 1 shows the implication of adding spices to Milk chocolate on the corresponding Total Calorific values of Milk Chocolate. Table 1 showed clearly the changes in the TCV values with different spices in kCal/200g of . the chocolate while figure 2 showed the percentage increase or decrease in TCV as a reslt of spice addition. Chocolates containing *Aframomum danielli* (A17) and the one into which *Aframomum melegueta* powders were added did not show any significant increase in the TCV values when compared to the control. However, black pepper showed a slight decrease in TCV but this was not significant. Other spices resulted in reduction of the TCV of milk chocolates which were in the range of 0.12% by C13 (Clove supplemented chocolate) to the chocolate into which Turmeric oowder was added having a percentage reduction in TCV of 54.49. The spices with the reduction in TCV as observed in this study were clearly in shown in the figure. According to figure 2, samples, C20, G11, G12, T15, T18, and C14 were responsible for perecentage reduction in the TCV

Conclusion

This study established the possibility of using spices in formulation of an innovative spicy Milk Chocolates. From our results the addition of spices resulted in an increase in Protein, Fat and reduction in Calories The sensory evaluation indicated a very acceptable scores for the chocolate into which spices were added which were comparable to the control chocolate without spices.

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