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Synergistic Effect of Spices and Herbs on Rheological and Bread Making Properties of Wheat Flour

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Cinnamon, clove, garlic, oregano and thyme were added at 1 or 2 % in wheat flour in combinations to investigate their effect on rheological and bread making properties. Incorporation of spices and herbs in combination significantly increased the water absorption (%) and dough development time as compared to control; while a decrease in dough stability was observed. Presence of spices and herbs significantly reduced the peak temperature and viscosities of the flour suspension. Bread was prepared by adding above mentioned spices and herbs and analyzed for baking and sensory quality. Spices and herbs significantly decreased the loaf volume and specific volume of the prepared bread. Spiced bread was liked by the panelist. Sensory scores for some combinations were higher than the control bread.

Keywords: Spices, Herbs, Rheological, Bread making, Wheat flour.

Spices and herbs have been used for distinctive flavors for foods and beverages around the world. They include any dried, fragrant, aromatic, or pungent vegetable or plant substance, in the whole, broken, or ground form, which contribute flavor and whose primary function in food is seasoning rather than nutrition, and that may contribute relish or piquancy to foods or beverages (Farrell, 1985). Most of the spices have added advantage of not only giving a flavor but also giving attractive colors to foods (Lewis, 1984). Apart from color and flavor, they are valued for their preservative and medicinal powers as well (Zaika, 1988). Spices and herbs can be used fresh, dried, whole, chopped, or ground due to their color, aroma or flavor characteristics in the preparation of foods and drink. Cinnamon sticks have been used to flavor tea. Its powder is used as an ingredient for red pepper spice mix and red pepper paste (Fullas, 2003).

Studies suggested that synergistic effect of spice and herbs is more beneficial than alone (Abdalla *et al*., 2007, Becerril *et al*., 2007). Combinations of spices and herbs not only enhanced the flavor but also increase the antimicrobial and antioxidant capacity of the product (Burt 2004, Goni *et al*., 2009). Lambert *et al*. (2001) reported that combination of carvacrol-thymol showed better antimicrobial activity against pathogenic micro-organisms.

Spices and herbs have been used as food ingredients in bakery products (Miller *et al*., 1997, Shan *et al*., 2005). Faheid (1999) studied the effect of flavorings of white pan bread with onion or garlic. Chomdao (2009) developed healthier bread by adding turmeric (*Curcuma longa*). Sirinard (2005) prepared bread by adding cinnamon and clove essential oils. Spices and herbs have the potential to be used as a functional ingredient in

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bakery products but very little information is available on their effects on dough rheology and bread quality. Present study was aimed to evaluate the change in dough behavior with the addition of spices and herbs. Spiced bread was prepared and analyzed for the quality attributes.

MATERIALS AND METHODS

Spices and herbs

Cinnamon, clove, garlic, oregano and thyme were purchased from the local market, dried, grounded, packed in sterilized bags and treated in a microwave at 916 MHz for 1 minute.

Proximate Composition of raw materials

Prescribed protocols of AACC (2000) procedures for moisture, ash, protein and fibre were thoroughly followed.

Determination of Total Phenolic Content

Total phenolic contents of oregano extracts were determined using Folin-Ciocalteu reagent as described by Singlaton and Rossi (1965). Samples were inserted into different test tube and mixed thoroughly with 5 mL Folin-Ciocalteu reagent (previously pre-dilute 10 times with distilled water). After 5 min, 4 mL of 7.5% sodium carbonate was added and allowed to react for 2 h at room temperature. The absorbance was measured at 765 nm using spectrophotometer. Samples were measured in three replicates. Standard curve of gallic acid solution (10, 20, 40, 60, 80 and 100 ppm) was prepared using the similar procedure. The results were expressed as mg GAE/100 g extract sample.

Preparation of blends

On the basis of initial trails cinnamon (2%), clove (1%), garlic (1%), oregano (2%) and thyme (2%) were selected for addition in wheat flour in combinations.

Farinographic curve characteristics

Effect of incorporation of spices and herbs on the farinographic curve characteristics of the wheat flour was studied as per AACC method (2000). Weighed samples (300g on 14 % moisture basis) were used and absorption adjusted to centring the curve on 500 BU line. From the farinograms the parameters assessed were: water absorption (%), dough development time (minute), dough stability (minute), mixing tolerance index (BU).

Pasting Properties

Flour pasting properties were determined using a rapid viscoanalyser (RVA) starch master R & D pack V 3.0 (Newport Scientific Narrabeen, Australia) (Batey *et al*., 1997). The RVA parameters measured were pasting temperature (^oC), peak viscosity (cP), holding viscosity (cP), final viscosity (cP) break down viscosity (cP), set back viscosity (cP).

Bread Making

Straight dough AACC method (2000) numbered 10-10 B was followed. The formula for control was as: flour-100 g, compressed yeast-3.0 g, sugar-2.5 g, bakery shortening-2.0 g, salt/NaCl-1.0 g, potassium bromated 1 ppm, water optimum. The dough was prepared and baking schedule is given as: fermentation-45 minutes, remixing-25 seconds, recovery-20 minutes, sheeting and moulding-3 minutes, proofing (at 86^{o}F, RH 75%)-55 minutes, baking-25 min at 450^{o}F.

Bread Quality

The loaves were analyzed for bread quality attributes. Loaf volume of bread was determined by the seed displacement method (Wang *et al*., 2002). Specific volume was calculated as the ration of the loaf volume to the loaf weight determined an hour after baking according to the method of Penfield and Campbell (1990).

Sensory Quality

Sensory evaluation for appearance, color, texture, flavor and overall acceptability was carried out next day by a panel of minimum ten semi trained judges on nine point hedonic scale (Larmond, 1970).

Texture Analysis

Hardness was measured as an index of bread texture by Stable Micro System Texture Analyzer Model (TA-H di England) using settings as Test-TPA, Probe-75 mm Cylindrical, Pre-test speed-1 mm/s, Test speed-1 mm/s, Post-test speed-1 mm, Force- 250 kg.

Statistical Analysis

The data collected on different characteristics were analysed with the help of factorial design in CRD using the software CPCS-1 (Singh *et al*., 1991). All results were expressed at 14% moisture basis unless otherwise stated. The results were expressed as means of triplicate values along with standard deviation (SD).

RESULTS AND DISCUSSION

Proximate composition and Total phenol content (TPC) of raw materials was presented in Table 1. Protein content ranged from 3.63% to 9.17%, wheat flour had the maximum protein content (9.17%). The results obtained were in association with findings of Pasha *et al* (2002). Clove had protein content (4.96%) followed by thyme (3.63%). Results obtained for protein content of clove were in close association with Gopalakrishna *et al*. (1988). Clove had a fibre content of 29.50% followed by cinnamon (27. 29%), thyme (17.71%) and oregano (17.43%), in the order. Tainter and Grenis (1993) reported the presence of 34.2% fibre in the dried clove powder. Results obtained for chemical composition for spices and herbs were in accordance with those reported by Pruthi (1976). Total phenol content (TPC) of spices and herbs showed significant variations. Clove had the highest phenolics contents (98.72mg GAE/ 100g DW). Oregano and cinnamon also contained high levels of phenolics (87.80 and 72.60mg GAE/ g DW, respectively). Similar results were reported by Zheng and Wang (2001).

Synergistic effect of spices and herbs on Farinogarphic curve characteristics of wheat flour

Farinogarphic curve characteristics of wheat flour incorporated with spices and herbs (cinnamon, clove, garlic, oregano and thyme) in combinations are presented in Table 2 and Fig. 1. Spices and herbs in combination increased the water absorption rate of flour as compared to control. Water absorption rate for flour blend contained cinnamon along with clove (2:1) and oregano and thyme (2:2) was 55.20% and 54.10 %, respectively. Maximum water absorption rate (56 %) was observed when cinnamon and thyme (2:2)

Table 1. Proximate composition of raw material

Samples	Moisture(%)	Protein(%)	Crude fibre(%)	TPC (mg GAE/100g DW
Wheat flour	12.03±0.56	9.17±1.09	0.49±0.02	3.78±0.21
Cinnamon	10.43±0.17	8.37±0.10	27.29±0.14	72.60±1.28
Clove	8.95±0.11	4.96±0.05	29.50±0.12	98.72±1.45
Garlic	8.32±0.15	8.16±0.11	2.76±0.02	37.80±2.41
Oregano	8.23±0.67	9.06±0.78	17.43±1.67	87.80±1.78
Thyme	11.17±0.12	3.63±0.05	17.71±0.14	46.50±1.09
CD (p≤0.05)	1.77	1.23	3.25	0.23

Means of three replicates ±SD

Table 2. Effect of incorporation of spices and herbs in combinations on farinographic characteristics on of wheat flour

Samples	Ratio	Level (%)	WA (%)	DDT (minutes)	DS (minutes)	MTI (B.U.)
Control	0	0	53.00±1.20	1.50±0.15	4.00±0.05	80.00±1.78
Cinnamon: Clove	2:1	3	55.20±1.30	2.00±0.09	2.50±0.05	90±1.15
Cinnamon: Garlic	2:2	4	52.90±0.75	1.75±0.11	2.00±0.08	120±2.56
Cinnamon: Oregano	2:2	4	55.40±0.98	2.50±0.08	2.50±0.23	90±2.10
Cinnamon: Thyme	2:2	4	56.00±1.10	2.00±0.12	2.00±0.07	100±1.17
Clove: Garlic	1:1	2	54.30±1.23	2.00±0.09	2.00±0.11	105±2.34
Clove: Oregano	1:2	3	55.00±1.17	3.05±0.09	2.50±0.11	95±2.14
Clove: Thyme	1:2	3	54.50±0.89	2.50±0.11	2.50±0.13	120±1.14
Garlic: Oregano	1:2	3	53.50±1.45	3.50±0.16	2.00±0.07	150±1.25
Garlic: Thyme	1:2	3	53.50±2.13	3.00±0.08	2.00±0.05	90±1.69
Oregano: Thyme	2:2	4	54.10±1.67	4.00±0.11	2.50±0.09	60±1.05
CD (p≤0.05)	0.63	0.21	0.10	1.55		

Mean of three replicates ±SD, WA-Water absorption, DDT-Dough development time
DS-Dough stability, MTI-Mixing tolerance index

was incorporated in the flour, followed by combination 2:2 of cinnamon: oregano in the flour (55.40%).

Dough development time increased significantly with the addition of spices and herbs in combinations in wheat flour as compared to control. Dough development time for control sample was 1.50 minutes, where as dough development time for blends ranged between 1.75 to 4.00 minutes. Dough development time for flour containing 2:2 cinnamon along with thyme and 1:2 clove along thyme was 2.0 and 2.5 minutes, respectively. Maximum dough development time (4.0 minutes) was observed in wheat flour incorporated with 2:2 oregano and thyme followed by 1:2 garlic: oregano (3.5 minutes). Minimum dough development time (1.75 minutes) was observed in flour blend with 2:1 cinnamon: garlic powder.

Variations were observed in dough stability after the incorporation of combinations of spices and herbs in wheat flour. Addition of spices and herbs decreased the dough stability as compared to control. Dough stability of blends ranged between 2 to 2.5 minutes. Dough stability of flour containing 2:2 cinnamon along with oregano and 1:2 garlic along with oregano was 2.5 and 2.0 minutes, respectively. Spices and herbs were rich in TPC (Table 1), which decreased the dough stability. Mixing tolerance varied significantly with the addition of combinations of

Table 3. Effect of incorporation of spices and herbs in combinations on pasting properties of wheat flour

Samples	Ratio	Level (%)	PT (°C)	PV (cP)	HV(cP)	FV(cP)	BDV(cP)	SV(cP)
Control	0	0	92.5±2.3	1650±125	980±25	1530±167	550±32	670±45
Cinnamon : Clove	2:1	3	92.78±1.98	1497±115	826±47	1320±139	494±25	671±59
Cinnamon: Garlic	2:1	3	93.00±2.13	1395±95	743±34	1250±250	507±19	652±52
Cinnamon: Oregano	2:2	4	93.38±2.67	1391±178	807±50	1281±267	474±29	584±21
Cinnamon: Thyme	2:2	4	93.95±3.14	1467±93	895±29	1390±145	495±45	572±49
Clove: Garlic	1:1	2	92.66±1.15	1479±85	886±45	1385±210	499±42	593±55
Clove: Oregano	1:2	3	92.6±1.89	1310±231	693±23	1210±123	517±40	617±47
Clove: Thyme	1:2	3	93.17±2.78	1484±139	869±50	1391±150	522±27	615±25
Garlic: Oregano	1:2	3	92.92±2.50	1269±175	627±38	1179±90	552±30	642±40
Garlic: Thyme	1:2	3	93.05±1.67	1378±121	841±47	1250±155	409±48	537±67
Oregano: Thyme	1:2	3	93.56±2.15	1369±190	750±50	1210±182	460±36	619±50
CD (p≤0.05)	0.21	6.14	35.64	26.51	9.87	8.56		

Mean of three replicates ±SD, PT-Paste Temp. (°C) PV-Peak viscosity (cP)HV-Hold viscosity(cP)FV-Final viscosity (cP) BDV-Break down viscosity(cP) SV-Setback viscosity (cP)

Table 4. Effect of incorporation of spices and herbs in combination on baking quality of bread

Samples	Ratio	Level (%)	Bake absorption (%)	Loaf volume (cc)	Specific volume (cc/g)	Hardness (N)
Control	0	0	69.33±0.56	675±2.67	4.96±0.13	1.39±0.05
Cinnamon: Clove	2:1	3	72.43±0.87	645±4.78	4.54±0.19	1.41±0.08
Cinnamon: Garlic	2:1	3	71.08±0.67	640±7.18	4.47±0.11	1.42±0.04
Cinnamon: Oregano	2:2	4	72.30±1.13	651±7.67	4.54±0.23	1.40±0.01
Cinnamon: Thyme	2:2	4	72.66±0.89	650±4.90	4.54±0.19	1.32±0.04
Clove: Garlic	1:1	2	72.33±0.66	625±5.70	4.43±0.10	1.36±0.05
Clove: Oregano	1:2	3	72.56±0.78	650±7.34	4.57±0.16	1.35±0.05
Clove: Thyme	1:2	3	72.00±0.65	640±9.34	4.53±0.11	1.37±0.02
Garlic: Oregano	1:2	3	71.83±1.03	642±4.35	4.43±0.15	1.43±0.5
Garlic: Thyme	1:2	3	71.66±0.79	626±5.78	4.33±0.23	1.45±0.03
Oregano: Thyme	2:2	4	73.00±0.58	650±7.02	4.47±0.11	1.40±0.04
CD (p≤0.05)	0.89	8.45	0.21	NS		

Mean of three replicates ±SD

spice and herb in the wheat flour. Mixing tolerance of blends varied between 60 to150 B.U. Mixing tolerance index of flour incorporated with 2:2 cinnamon along with thyme and 1:2 clove and garlic was 100 and 105 B.U., respectively. Flour having 1:2 garlic and oregano had maximum tolerance index (150 B.U.), followed by 1:2 clove along with thyme (120 B.U.). Minimum mixing tolerance index (60) was seen in blend containing 2:2 oregano and thyme. Miller *et al* (1997) reported that the addition of garlic to wheat flour dough causes it to rapidly break down during mixing but the cause of that effect is unknown. According to Faheid (1999) low concentration of garlic or onion either powder or volatile oil caused an improving effect on dough stability or departure time, while at high levels of addition caused an adverse effect. Sudha *et al*. (2007) reported that apple pomace, a rich source of fibre and polyphenols, increased the water absorption and mixing tolerance index while dough stability was decreased, indicating weakening of the dough. Gomez *et al*. (2003) found that fiber had pronounced effects on dough rheological behavior yielding higher water absorption and smaller extensibility. Koca and Anil (2007) studied the rheological properties of flaxseed supplemented flour and observed an increased in water absorption, dough development time and mixing tolerance index and decrease in dough stability.

Effect of incorporation of spices and herbs in combination on pasting properties of wheat flour

Data showing the synergistic effect of spices and herbs on pasting properties of wheat flour are given in Table 3. Combinations of spices and herbs in wheat flour increased the paste temperature as compared to control. Paste temperature of flour incorporated with 2:1 cinnamon along with garlic and 2:2 cinnamon along with oregano was 93.00 and 92.38°C, respectively. Maximum increase in paste temperature (93.95°C) was observed in wheat flour blend with 2:2 cinnamon and thyme, followed by flour incorporated with 2:2 oregano along with thyme (93.56°C). A significant decrease in peak viscosities of flour blend with combinations of spices and herbs was observed as compared to control. Peak viscosity for control sample was 1650cP. Peak viscosities for blends varied between 1269cP to 1497cP. The peak viscosity of flour incorporated with 2:2 cinnamon along with oregano and 1:2 clove along with thyme was 1391cP and 1484 cP, respectively. Maximum peak viscosity (1497) was observed in flour supplemented with 2:1 cinnamon and clove. Flour incorporated with 1:2 garlic and oregano had lowest peak viscosity (1269cP). Incorporation of spices and herbs in combinations significantly decreased the hold viscosity of flour blends as compared to control. The hold viscosity

Table 5. Effect of incorporation of spices and herbs in combination on the mean sensory panel scores (Max 9) of bread

Samples	Ratio	Level	Parameters				
		(%)	Appearance	Color	Texture	Flavor	Overall acceptability
Control	0	0	8.00±0.10	7.90±0.14	8.16±0.31	7.66±0.24	7.93±0.12
Cinnamon: Clove	2:1	3	8.00±0.13	8.20±0.15	7.83±0.19	7.56±0.11	7.89±0.16
Cinnamon: Garlic	2:1	3	7.44±0.14	7.44±0.11	7.20±0.21	6.40±0.16	7.12±0.13
Cinnamon: Oregano	2:2	4	8.03±0.19	8.40±0.10	7.83±0.23	8.28±0.15	8.13±0.25
Cinnamon: Thyme	2:2	4	8.43±0.21	8.09±0.15	8.43±0.21	7.56±0.14	8.38±0.15
Clove: Garlic	1:1	2	7.00±0.14	7.16±0.17	7.50±0.11	7.44±0.12	7.25±0.17
Clove: Oregano	1:2	3	8.23±0.11	8.40±0.18	7.83±0.17	8.50±0.11	8.20±0.11
Clove: Thyme	1:2	3	7.90±0.26	7.96±0.11	8.06±0.18	7.85±0.12	7.94±0.15
Garlic: Oregano	1:2	3	7.90±0.11	8.00±0.11	8.00±0.21	7.96±0.15	7.96±0.11
Garlic: Thyme	1:2	3	7.76±0.09	7.60±0.23	7.93±0.24	7.03±0.17	7.58±0.19
Oregano: Thyme	1:2	3	8.00±0.13	7.50±0.24	7.50±0.28	8.00±0.15	7.75±0.12
CD ($p \leq 0.05$)			0.37	0.23	0.26	0.54	0.31

Mean of three replicates ±SD

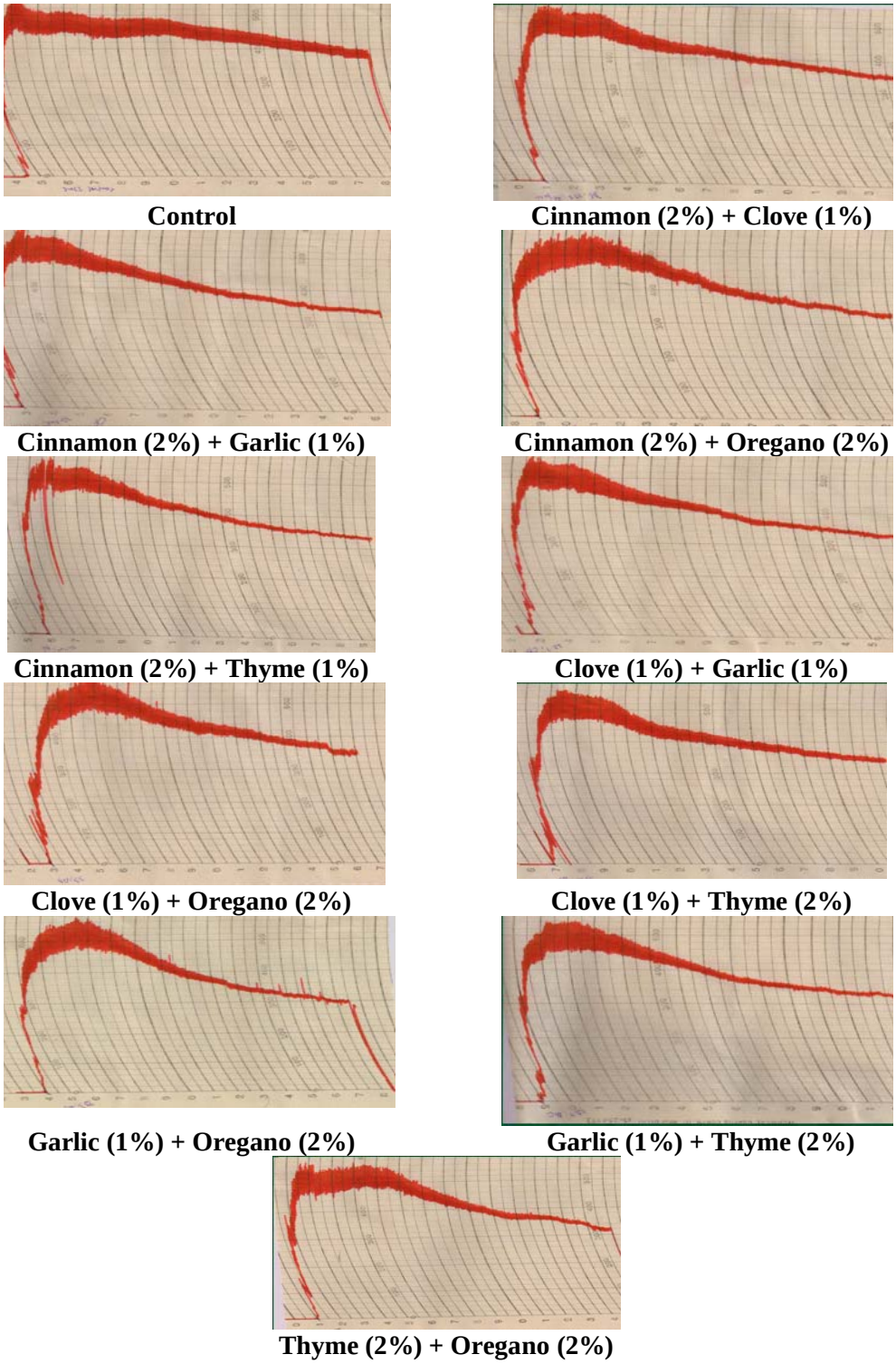

Fig. 1. Effect of incorporation of spices and herbs in combinations on farinographic characteristics on of wheat flour

of flour incorporated with 2:1 cinnamon along with garlic and 2:2 cinnamon along with oregano was 743cP and 807cP, respectively. Flour supplemented with 2:2 cinnamon along with thyme had maximum hold viscosity (895cP), followed by flour incorporated with 1:1 clove and garlic (886cP).

Minimum hold viscosity (627cP) was observed in flour incorporated with 1:2 garlic along with oregano, followed by flour supplemented with 1:2 clove and oregano (693cP) in the order. Addition of spices and herbs in combination significantly decreased the final viscosity as compared to control. Maximum final viscosity (1390cP) was observed in flour incorporated with 2:2 cinnamon along with thyme followed by 1:1clove and garlic (1385cP). Minimum final viscosity (1179cP) was observed in flour incorporated with 1:2 garlic along with oregano, followed by flour supplemented with 1:2 clove along with oregano and 1:2 oregano: thyme (1210cP).

Combinations of spices and herbs significantly decreased breakdown viscosity of supplemented flour as compared to control. The breakdown viscosity of flour incorporated with 2:1 cinnamon along with garlic and 2:2 cinnamon along with oregano was 507cP and 474 cP, respectively. Flour supplemented with 1:2 garlic along with oregano had maximum breakdown viscosity (552 cP), followed by flour incorporated with 1:2 clove and thyme (522cP). Minimum breakdown viscosity (409cP) was observed in flour incorporated with 1:2 garlic along with thyme. A significant decrease in setback viscosity of flour blend with combinations of spices and herbs was observed as compared to control except for flour incorporated with 2:1 cinnamon and clove (671cP), similar to control (670cP). Peak viscosities for blends varied between 537 to 671cc. Setback viscosity of flour incorporated with 2:2 cinnamon along with oregano and 1:2 clove along with thyme was 584cP and 572cP, respectively. Pasting properties of wheat flour are primarily related to the swelling and rupture of starch granules in a system (Rojas *et al*., 1999). Different food additives in the system can alter the pasting behavior to various extents. Phenolic compound present in spices and herbs (Shan *et al*., 2005) lowered the pH of the flour suspension and thus starch molecules collapse under hydrothermal treatments (Gunaratne and Corke, 2007, Rodriguezsosa *et al*., 1981; Bao and Corke, 2002). Wheat starch when subjected to hydrothermal treatment, gelatinization of starch leads to granule swelling. Saturated starch granule rupture to form paste, upon cooling starch granules starts retrogradation. Presence of food additives in wheat flour influence the rheological properties of the dough. Change in pasting and rheological properties of starch was reported by Juszczak *et al*. (2004), Chaisawang and Suphantharika, (2006), Beta and Corke, (2004).

Effect of incorporation of combination of spices and herbs on baking quality and firmness of bread

Effect of combination of spices and herbs on baking quality and firmness of bread is presented in Table 4. Significant variations were observed in baking absorption, loaf volume and specific volume in breads made from combinations of spices and herbs. Baking absorption of breads prepared after incorporation of combinations of spices and herbs was high as compared to control. Maximum baking absorption was (73%) observed in bread prepared by adding 2:2 oregano and thyme herb followed by bread prepared after incorporating 2:2 cinnamon and thyme. Baking absorption at this level was 72.66%. Loaf volume of bread prepared from combinations of spices and herbs were in the range of 4.33 to 4.57cc, which was comparable to control bread (4.96cc). Specific volume of bread prepared by adding spices and herbs varied significantly. Specific volume of control bread was 4.96cc/g. Specific volume of bread prepared by incorporating spices and herbs varied from 4.57cc/g to 4.33cc/g. Decrease in loaf volume was due to decreased gas holding capacity of dough incorporated with spices and herbs. A reduced volume might be attributed to gluten dilution as proposed by Pomeranz *et al.* (1987) and Dubois (1978).

Non-significant variations were observed for bread firmness. Firmness for control sample was 1.39 N. Firmness for the bread prepared from flour supplemented with combination of 2:2 cinnamon along with thyme, 2:2 cinnamon and oregano was 1.32 and 1.40N, respectively. Maximum hardness was 1.45N for 1:2 garlic and thyme combination used for bread making.

Effect of incorporation of spices and herbs in combination on organoleptic quality of bread

The effect of combination of spices and herbs on the mean sensory panel scores of bread is discussed in Table 5. Significant variations were

observed with regard to organoleptic quality (appearance, color, texture, flavour and overall acceptability).

Scores given for appearance of bread prepared from combination of spices and herbs varied significantly. Score for the appearance of bread prepared from flour supplemented with combination of 2:2 cinnamon powder along with thyme herb, 1:2 clove and oregano and 2:2 cinnamon and oregano were more i.e. 8.43, 8.23 and 8.03, respectively as compared to control which were 8.00. So the appearance of bread improved by the combinations of spices and herbs. Score for the color of bread prepared after incorporation of combination of spices and herbs varied significantly. Maximum score for color were awarded to bread prepared after incorporation of combination of 2:2 cinnamon along with oregano, 1:2 clove and oregano (8.40) followed by bread prepared by adding 2:1 cinnamon and clove in the flour (8.20).

Significant variations were observed in texture of bread prepared by combinations of spices and herbs. Texture score for bread prepared by adding 2:2 cinnamon and thyme was 8.43, which was significantly more than control (8.16). Score for the flavor of bread prepared after incorporation of 1:2 clove and oregano were more i.e. 8.50 as compared to control which was 7.93. Similarly, score for the flavor of bread prepared after incorporation of 2:2 cinnamon and oregano was 8.60. Score for the flavor of bread prepared from flour supplemented with combination of 2:2 cinnamon and thyme was 7.56. Flavor of the bread with incorporation of spices and herbs improved as predicted by the panelists. Lim *et al*., (2010) prepared bread by turmeric (*Curcuma longa L*.) powder and reported its acceptability ahead of white bread. Bread flavouring with onion and garlic (powders or volatile oils) at low levels were considered by some panelists to have more pleasant flavours than the control bread (Faheid, 1999). On the basis of sensory scores, bread prepared from combination of clove: oregano 1:2, cinnamon: oregano 2:2, cinnamon: thyme 2:2 was 8.20, 8.13 and 8.38 for further investigation.

CONCLUSIONS

Incorporation of spices and herbs into wheat flour remarkably influenced the farinographic and pasting properties of dough. Addition of spices and herbs increased the water absorption of flour whereas dough stability and mixing tolerance was decreased. Overall Addition of spices and herbs had a weakening effect on dough properties. Presence of spices and herbs reduced the peak, hold, final and breakdown viscosities of the flour suspension. Specific volume of spiced bread was less than the control. However, the sensory scores of prepared bread were in high acceptable range. The present study has indicated that spices and herbs can be added as a functional ingredient without much effective its baking and sensory qualities.

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