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Keywords : Microbial Load, Organoleptic Properties, Shelf Life.

I. Introduction

Baking is a food cooking method using prolonged dry heat acting by convection and not by thermal radiation, normally in an oven. Baking is the process of using food ingredients and formulas, or recipes to cook food or bake a food product.It is primarily used for the preparation of bread, cakes, pastries and pies, tarts, quoches cookies and crackers (Mridula *et al*, 2007). Biscuits are ready-to-eat, cheap and convenient food product that is consumed among all age groups in many countries (Hussein *et al,* 2006; Iwegbue, 2012). Biscuits have been reported to be rich in fat and carbohydrate; hence they can be referred to as energy giving food as well as good sources of protein and minerals (Kure *et al*, 1998). The main ingredient generally used for biscuit production is wheat flour with other ingredients such as margarine (shortening), sweeteners (sugar), leaving agents, eggs, milk, salt and flavours (Ghattas *et al,* 2008). In many parts of sub-Saharan Africa and most especially Nigeria, advancing prosperity and urbanization couple with tremendous increase in population. In recent years have led to an increase in the consumption of wheat-based products especially biscuits and breads. However, the production of wheat in Nigeria is extremely low far below domestic requirements.

Wheat flour is a powder made from the grinding of wheat used for human consumption. Wheat flour is the most common flour used in baking different between bread flour and cake flour. Wheat protein is easily digested by nearly 99% of human. So is its starch. Wheat also contains a diversity of minerals, vitamins and fats (lipids). With a small amount of animal or legume protein added a wheat-based meal is highly nutritious. Sorghum is one of the crops grow in many African countries primarily as food crop with less than 5% of the annual production commercially processed by the industry (Rohrbach and Kiriwaggulu, 2008; Okoli *et al*, 2010). Sorghum grain ranks third among the domesticated cereals for human consumption and is a staple food in many African countries, India and China (Elkhalifa and El-Tinay, 2002; Awadalkareem *et al,* 2008; Elemo *et al*, 2011; Mohammed et al, 2011).

Curry power *Murraya koenigi* is a spice mixture of widely varying composition developed by the British during the days of the Indian Cuisine at home. Curry powders and pastes produced and consumed in India are extremely diverse, some red, some yellow, some brown, some with five spices and some with as many as 20 or more. Besides the previously mentioned spices, other commonly found spices, white pepper, ground mustard, ground ginger, cinnamon, roasted cumin, cloves, nutmeg, mace, green, cardamom seeds or black cardamom pods, bay leaves and coriander seeds (Adebowale *et al,* 2008).

Shelf life is the recommendation of time that products can be stored, during which the defined quality of a specified proportion of the goods remains acceptable under expected condition of distribution, storage and displays. Most food products shelf life are increased using preservative – A preservative is a naturally occurring or synthetically produced substances

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e.g. (salt) that are added to product such as foods, pharmaceutical paints, biological samples, woods etc. to prevent decomposition by microbial growth or by undesirable chemical changes (Gyesley, 2008).

The present work aimed to know the effect of spices *Murraya koenigi* shelf life of biscuit produced from blends of sorghum flour and wheat flour.

II. Materials and Method

a) Collection and Processing of Raw Materials and Baked Products

sorghum and wheat was collected from a local market Oja-Ikoko, in Owo Town, Ondo State and the dirt's, stones and other extraneous material was picked and the wheat was grinded using a laboratory hammer mill to pass through a 0.4mm screen (Elkhalfa and El-Tinay, 2002) and pulverized. Bakery products, sugar, eggs, margarine, milk and salt were also gotten from the same market.

i. *Preparation of Composite Flour and Cookies (Biscuit)*

Ten composite flours was prepared by substituting melon flour and wheat flour with 5g and 10g of Curry power *Murraya koenigi* in the blends proportion of 100;0, 70;30, 50;50, 30;70, 0;100 for 5g and 10g respectively. Biscuit was produced from the composite flours and spices according to the method of Giwa *et al* (2012).

ii. *Physical Analysis of the Biscuit*

The diameter and height of the biscuit produced was measured with a calibrated ruler as described by (Opawale *et al*., 2011, Giwa *et al*., 2012).

iii. *Microbial Evaluation of the Biscuit*

Microbial count was determined according to standard method described by (Giwa *et al*., 2012, Umoh *et al*., 2004, Onuorah and Akijede 2004). This microbial analysis was carried out immediately after production and two weeks interval to the storage times of six weeks.

iv. *Sensory Evaluation of the Biscuit*

The organoleptic evaluation of the biscuit sample was carried out for consumer acceptance and performance using five trained panelist (student and staff of the Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria) (Opawale *et al*., 2011). This sensory analysis was carried out immediately after production and two weeks interval to the storage times of six weeks. The result was recorded in triplicate ± standard deviation, and analyzed using statistical tool t-test and Duncan to separate the means.

III. Statistical Analysis

The value of result was obtained in duplicate and was used to calculate the mean ± standard deviation. The data obtained were statistically analyzed using studentize t-test and analysis of variance (ANOVA).

IV. Discussion

The physical analysis of biscuit produced from blends of sorghum flour and wheat flour spiced with curry *(Murraya koenigii)* show in table 1 revealed a corresponding increase from 5g to 10g. This observation is contrary to the result of Oluwamukomi *et al*, 2005, who observed decrease in spread ratio. The increase in the spread ratio with increase in spiced concentration shows that the starch polymer molecules are loosely bond with granules and swelling is not limited with wheat flour when heated. The increase in the concentration of wheat flour revealed increase in the spread ratio.

Table 2, 3 and 4 below shows the microbial count of the produce cookies at immediately after production, two weeks after and five week after production respectively. Increase in the spice concentration induced a noticeable reduction in the microbial load. The total microbial load on nutrient range from 6.0×10^4, 4.0×10^4 and 1.0×10^4 Cfu/g. This result compare with microbiological standard of blend foods is within satisfactory acceptable range $<10^5$ (NZFSA, 2005). The result is still within acceptable value. Significant reduction in the total viable count of the microbial isolates on nutrient agar was attributes to increase in the concentration of the spice (*Murraya koenigii*). It has been recorded that, *Murraya koenigii* has antimicrobial properties (Ningappa *et al*., 2008). The corresponding increase in the spice (*Murraya koenigii*) concentration also leads to corresponding decrease in *Staphylococcus counts* at each category respectively and the results fall into the microbiological specification for *Staphylococcal* count ranges form ($10^2 - 10^3$) at the concentration of 5g and 10g respectively. The result for staphylococcus count for 70:30, 50:50 and 30:70 sorghum flour-Wheat flour reveals count within the marginally acceptable range compare microbiological specification ($10^2 - 10^4$) (NZFSA, 2005). Coliform count reveals no growth on Eosin Methylene Blue agar (EMB) for all the blends. This show that the raw material before and during production are free for feacal contamination. The table of the biscuit stored for three weeks shows that the bioload are within the acceptable range and there was no significant difference on microbial load compared with biscuit produce immediate after production at probability level $P<0.05$ but there was a noticeable increase on the bioload of the biscuits at the storage period of 6 weeks. This show that the application of curry *(Murraya koenigii)* as a noticeable effect on the microbial load produce from sorghum flour and wheat flour blend as it keep the microbial load below microbiological below the standard.

Sensory evaluation of biscuit produced from sorghum flour blend with wheat flour spiced with curry (*Murraya koenigii*). The organoleptic evaluation of biscuit show in table 5,6 and 7 revealed that there were no significant different on the sensory property at probability level $P<0.05$ using student T-test to compared the mean of the result of concentration of 5g and 10g of curry spice immediately after produced. This implies that spice concentration can still be increased for further antimicrobial effect to be exacted without having effect on the sensory property of the produced biscuits. Following storage, every two weeks intervals there was no much difference on the sensory property and overall acceptability for 6weeks. This could implies that the spice impact on a longer shelf-life on the produced product as the biscuit retain its sensory property over a particular period of storage time. The colour of biscuits changes from creaming to dark brown with the increase in the trends of sorghum flour. Taste is the primary factor that determines the acceptability of a product which as the highest impact as far market product is concerned (Banureka and Mahendran, 2009). The score of taste for six weeks of storage period ranges from 3.0-5.0 i.e. from neither like nor dislike to extremely liking. The cripiness was related to the external appearance of the biscuit top which smoothness or roughness of crust. The texture crust for six week of storage revealed no significant different. The overall acceptability also revealed there is no significant difference from the data collected as the spice increase from 5g to 10g concentration, using T-test as the statistical tool to analyze the differences.

V. Conclusion and Recommendation

Sorghum is one of the useful food crops that contain important nutrients for man and his livestock. Wheat flour is the most common flour used for human consumption. The present of the spice (*Murraya koenigii*) in the finished cookies products produces significant effect on microbiological load. This could be attributed to the increase in the concentration of the spice (*Murraya koenigii*) that lead to satisfactory acceptable range in the microbial load in all the categories. It can be controlled that the spice (*Murraya koenigii*) produced no significant effect on the physical properties as the diameter, height and spread factors varied significantly, at probability level $P < 0.05$ as concentration of the spice (*Murraya koenigii*) increase. It can also be concluded that, there is no significant difference on the effect of the spice (*Murraya koenigii*). On the sensory properties of cookies produced from sorghum flour fortified with wheat flour as the spice concentration increase. It can there be recommend that the production of cookies from sorghum flour fortified with wheat flour spiced with curry (*Murraya koenigii*) be encouraged to achieve and harvested the preservatives potential of the spice (*Murraya koenigii*) and the other medicinal properties that has been recorded from literature review.

References Références Referencias

1. Adebowale, A. A, Sanni, L. O. and Onitilo, M. O. (2008) Chemical Composition and Pasting Properties of Tapioca Grits from Different Cassava Varieties and Roasting Methods. *Africa. Journal Food Science*, 2:77-82.
2. Awadalkareem, A. M., Mustafa A. I. and El-Tinay, A. H. (2008) Protein, Mineral Content and Amino Acid Profile of Sorghum Flour as Influenced by Soybean Protein Concentrate Supplementation Pakistan. *Journal Nutrition*, 7:475-479.
3. Banureka V.D. and Mahendran T., 2009. Formulation of Whea-Soybean Biscuits and Their Quality Characteristics. Tropical Agricultural Research & Extension, 12(2): 62-66.
4. Elemo, G. N., Elemo, B. O. and Okafor, J. N. C. (2011) Preparation and Nutritional Composition of a Weaning Food Formulated from Germinated Sorghum (Sorghum Bicolor) and Steamed Cooked Cowpea (Vigna Unguiculata Walp). *America Journal Food Technology*, 6:413-421.
5. Elkhalifa, A. E. O. and El-Tinay, A. H. (2002) Effect of Cysteine on Bakery Products from Wheat-Sorghum Blends. *Food Chemistry*, 77:133-137.
6. Ghattas, L. A., Hanna, L. M., Tapozada, S. T. and El-Shebini, S. M. (2008) Some Complementary Hypoglycemic Supplements from Grain Legumes for the Management of Type 2 Diabetic Mellitus. *Journal Medical Science,* 8:102-110.
7. Giwa O. E, Babalola R. O. and Atanlogun K. S. (2012) Microbial, Physical and Sensory Attribute of Cookies Produced from Wheat Flour Fortified with *Termitomyces robustus* and Spiced with Curry Leave (Xylopia aethoipica), *Journal of Natural Science Research*, Volume 2, No. 3 Pp 40-46.
8. Gyesley, S. W. (2008), Total System Approach to Predict Shelflife of Packaged Foods. ASTMSTP 113-EB.
9. Hussien, H. M, Hussein, M. M and El-Damohery, S. T. (2006) The Effect of Natural Formulated Functional Biscuits on Elderly Bone Health. *Journal Medical Science*, 6:937-943.
10. Iwedbue, C. M. A. (2012) Metal Contents in Some Brands of Biscuit Consumed in Southern Nigeria. *America. Journal Food Technology,* Volume 3, No. 5 Pp. 160 – 167.
11. Kure, O. A, Bahayo, E. J. and Daniel, E. A. (1998) Studies on the Proximate Composition and Effect of Flour Particle Size on Acceptability of Biscuit Produced from Blends of Soya Beans and Plantain Flours. *Namida Technology-Scope Journal*, 3:17-21.

12. Mohammed, M. A. E, Makki, H. M. M. and Mustafa, A. E. M. I. (2011) Production of Cereal-Based Infant Food from Sorghum (*Sorghum bicolor* (L) *moench*) and Pigeon Pea (*Cayanus cajan*). *Pakistan Journal* Nutrition, 10:910-913.
13. Mridula, D., Gupta, R. K. and Manikanban, M. R. (2007) Effect of Incorporation of Sorghum Flour to Wheat Flour on Quality of Biscuits Fortified with Defatted Soy Flour. *America Journal Food Technology*, 2:428-434.
14. New Zealand Food Safety Authority (2005) A Guide to Calculating Shelflife of Food pg 11 – 17.
15. Ningappa, M.B., Dinesha, R., and Srinivas, L. (2008) Antioxidant and free radical scavenging activities of polyphenol-enriched curry leaf (Murraya koenigii L.) extracts. Food Chemistry 106: 720-728.
16. Okoli, E. V., Okolo, B. N., Moneke, A. N. and Ire, F. S. (2010) Effects of Cultivar and Germination Time on Amylolytic Potential, Extract Yield and Worth Fermenting Properties of Malting Sorghum. *Asian Journal Biotechnology*, 2:14-26.
17. Oluwamukomi M.O., Adeyemi I.A. and Oluwana I.B. (2005): Effects of soybean enrichment on the physicochemical and sensory properties of gari. *Application Tropical Agriculture*. 10: pp 44-49
18. Onuorah C.E. and Akinjede E.A. (2004): Comparative Evaluation of, *I Journal* 22, 48-53.
19. Opawale, B.O., Giwa O.E, Jose O.R., Aladejimokun O.A. and Aladenika A. K. (2011): Physical, Sensory and Microbial Attributes of Taro flour supplemental Cookies. *National Conference Proceedings on Interdisciplinary Cooperation. A Panacea for Food Security page 1:6.*
20. Umoh V.J. Oransi, S.U. and Kwaga J.K.P. (2004): The Public Health Significance of Pathogens Isolated from Kunun-zaki sold in Retail Outlet in Zaria, Nigeria. *Nigeria Food Journal* 22:10-17.
21. Rohrbach, D. D. and Kiriwaggulu, J. A. B. (2008). Commercialization Prospects for Sorghum and Peal Millet in Tanzania. Working Paper Series No. 7 Bulawayo Zimbabwe/Socio-Economic and Policy Programme ICRISAT.

Table 1: Physical Analysis of Biscuit Produced from the Blends of Sorghum Flour and Wheat Flour Spiced with Curry (*Murraya koenigii*).

SF:WF 100:0%	DIAMETER	HEIGHT	SPREAD FACTOR
5g	4.5	0.5	0.9 x 103
10	4.2	0.5	0.84 x 103
70:30%			
5g	3.6	0.6	0.6 x 103
10g	4.2	0.5	0.84 x 103
50:50%			
5g	6.3	0.5	1.26 x 103
10g	3.2	0.6	0.5 x 103
30:70%			
5g	6.2	0.4	1.55 x 103
10g	6.2	0.4	1.55 x 103
0:100%			
5g	4.5	0.4	0.9 x 103
10g	4.2	0.4	0.84 x 103

Table 2 : Microbial Preparation of Biscuit Produced from the Blends of Sorghum Flour and Wheat Flour Spiced with Curry (*Murraya koenigii*) immediately After Production.

Sorghum Flour: Wheat Flour	Spice concetratior	A	B	C	D	E	F
100% SF:	5g	$2.0x10^3$	Nil	$2.5x10^3$	$1.0x10^3$	$7.0x10^3$	Nil
0% WF	10g	$1.2x10^3$	Nil	$7.0x10^3$	$1.1x10^3$	$4.0x10^3$	Nil
70% SF:	5g	$1.0x10^3$	$7.5x10^3$	Nil	Nil	Nil	Nil
30% WF	10g	$2.0x10^3$	$3.0x10^3$	Nil	Nil	Nil	Nil
50% SF:	5g	$9.5x10^3$	$1.1x10^3$	Nil	Nil	$3.0x10^3$	Nil
50% WF	10g	$4.0x10^3$	$7.0x10^3$	Nil	Nil	$2.0x10^3$	Nil
30% SF:	5g	$6.0x10^3$	$2.5x10^3$	$3.1x10^3$	$2.0x10^3$	$8.0x10^3$	Nil
70% WF	10g	$5.0x10^3$	$2.0x10^3$	$1.2x10^3$	$1.4x10^3$	$6.0x10^3$	Nil

Table 3 : Microbial Preparation of Biscuit Produced from the Blends of Sorghum Flour and Wheat Flour Spiced with Curry (*Murraya koenigii*) after 3 Weeks after production.

Sorghum Flour: Wheat Flour	Spice	A	B	C	D	E	F
100% SF:	5g	$2.5x10^3$	Nil	$5.0x10^3$	$2.6x10^3$	$1.4x10^3$	Nil
0% WF	10g	$1.6x10^3$	Nil	$1.1x10^3$	$2.2x10^3$	$7.0x10^3$	Nil
70% SF:	5g	$2.4x10^3$	$1.5x10^3$	$1.5x10^3$	Nil	Nil	Nil
30% WF	10g	$4.6x10^3$	$7.0x10^3$	$7.0x10^3$	Nil	Nil	Nil
50% SF:	5g	$1.9x10^3$	$2.1x10^3$	Nil	Nil	$6.0x10^3$	Nil
50% WF	10g	$9.2x10^3$	$1.5x10^3$	Nil	Nil	$4.0x10^3$	Nil
30% SF:	5g	$1.2x10^3$	$7.6x10^3$	$6.3x10^3$	$4.0x10^3$	$1.6x10^3$	Nil
70% WF	10g	$1.0x10^3$	$3.3x10^3$	$2.4x10^3$	$2.8x10^3$	$1.2x10^3$	Nil

Table 4 : Microbial Preparation of Biscuit Produced from the Blends of Sorghum Flour and Wheat Flour Spiced with Curry (*Murraya koenigii*) After 5 Weeks production.

Sorghum Flour: Wheat Flour	Spice	A	B	C	D	E	F
100% SF:	5g	$3.6x10^4$	$9.0x10^3$	$7.0x10^3$	$2.96x10^4$	$3.96x10^4$	Nil
0% WF	10g	$3.6x10^3$	$1.0x10^3$	$2.2x10^3$	$3.2x10^3$	$1.3x10^3$	Nil
70% SF:	5g	$2.48x10^4$	$2.15x10^4$	$2.08x10^4$	$4.0x10^3$	Nil	Nil
30% WF	10g	$2.0x10^3$	$1.5x10^3$	$9.6x10^3$	$1.0x10^3$	Nil	Nil
50% SF:	5g	$5.96x10^4$	$4.3x10^3$	Nil	Nil	$1.5x10^3$	Nil
50% WF	10g	$2.74x10^4$	$1.8x10^3$	Nil	Nil	$9.0x10^3$	Nil
30% SF:	5g	$1.57x10^4$	$1.0x10^3$	$9.7x10^3$	$5.0x10^3$	$4.2x10^3$	Nil
70% WF	10g	$1.08x10^4$	$5.6x10^3$	$5.4x10^3$	$3.6x10^3$	$3.6x10^3$	Nil

A: Total viable count on Nutrient Agar (N.A)

B: Total *Staphylococcus* count on Manitol Salt Agar (M.S.A)

C: Total Bacillus count on Tryptone Soy Agar (T.S.A)

D: Total haemolytic bacteria count on Blood Agar (B.A)

E: Total fungi count on Malt Extract Agar (M.E.A)

F: Total coliform count on Eosine Methylene Blue (E.M.B)

Table 5 : Sensory Evaluation of Biscuit Produced from the Blends of Sorghum Flour and Wheat Flour Spice with Curry (*Murraya koenigii*) immediately after production.

Sorghum Flour/Wheat Flour	Taste	Colour	Cripiness	Odour	General Acceptability
100:0%	b 3.8 ± 0.45	ab 4.2 ± 0.84	cd 24.2 ± 0.84	bc 3.4 ± 0.89	ab 4.2 ± 0.45
	b 3.6 ± 0.90	ab 4 ± 0.71	cd 2 ± 0.71	c 2.8 ± 1.5	c 3.6 ± 1.14
70:30%	a 4.6 ± 0.55	ab 4.2 ± 0.84	bc 3.4 ± 1.34	c 2.6 ± 1.1	bc 3.4 ± 1.14
	ab 4.4 ± 0.89	ab 4.4 ± 0.55	a 4.8 ± 0.45	c 2.8 ± 0.84	b 3.6 ± 1.15
50:50%	bc 3.4 ± 0.90	bc 3.4 ± 1.14	c 2.6 ± 1.5	b 3.8 ± 0.84	b 3.8 ± 0.84
	b 3.6 ± 0.90	bc 3 ± 0.71	cd 2.2 ± 1.3	bc 3 ± 1.41	4.4 ± 0.55
30:70%	b 3.8 ± 0.84	bc 3.4 ± 0.89	c 1.4 ± 0.89	bc 3 ± 1	b 3.8 ± 0.84

	ab 4 ± 0.71	b 3.6 ± 1.14	2.6 ± 1.14	c 2.6 ± 0.55	b 3.8 ± 1.1
0:100%	b 3.8 ± 0.84	b 3.8 ± 1.1	d 1.8 ± 0.84	bc 3.2 ± 0.84	bc 3.4 ± 0.89
	b 3.8 ± 0.84	c 2.8 ± 0.45	d 1.6 ± 0.55	bc 3.4 ± 0.55	bc 3.2 ± 0.89

Table 6 : Sensory Evaluation of Biscuit Produced from the Blends of Sorghum Flour and Wheat Flour Spice with Curry (*Murraya koenigii*) three weeks after production.

Sorghum Flour/Wheat Flour	Taste	Colour	Cripiness	Odour	General Acceptability
100:0%	b 3.8 ± 0.45	ab 4.2 ± 0.84	bc 3.4 ± 0.89	c 2.2 ± 0.83	ab 4.2 ± 0.44
	b 3.6 ± 0.90	ab 4.0 ± 0.70	c 2.8 ± 1.49	cd 2.0 ± 0.70	ab 4.4 ± 0.54
70:30%	a 4.6 ± 0.55	ab 4.2 ± 0.83	c 2.6 ± 1.14	bc 3.4 ± 1.34	bc 3.4 ± 1.14
	ab 4.4 ± 0.90	ab 4.4 ± 0.54	c 2.8 ± 0.83	a 4.8 ± 0.44	bc 3.0 ± 0.73
50:50%	bc 3.4 ± 0.90	bc 3.4 ± 1.14	b 3.8 ± 0.83	b 3.6 ± 1.51	bc 3.4 ± 1.54
	b 3.6 ± 0.90	bc 3 ± 0.70	bc 3.0 ± 1.41	cd 2.2 ± 1.30	cd 2.4 ± 1.14
30:70%	b 3.8 ± 0.84	bc 3.4 ± 0.89	bc 3 ± 1	c 1.4 ± 0.89	c 2.6 ± 0.54
	ab 4 ± 0.71	b 3.6 ± 1.14	c 2.6 ± 0.54	c 2.6 ± 1.14	bc 3.2 ± 0.83
0:100%	b 3.8 ± 0.84	b 3.8 ± 1.09	bc 3.2 ± 0.83	d 1.8 ± 0.83	d 1.8 ± 0.83
	b 3.8 ± 0.84	c 2.8 ± 0.44	bc 3.4 ± 0.54	d 1.6 ± 0.54	bc 1.8 ± 0.83

Table 7 : Sensory Evaluation of Biscuit Produced from the Blends of Sorghum Flour and Wheat Flour Spice with Curry (*Murraya koenigii*) six weeks after production.

Sorghum Flour/Wheat Flour	Taste	Colour	Cripiness	Odour	General Acceptability
100:0%	d 1.8 ± 0.83	3.6 ± 0.54	cd 2.4 ± 0.54	cd 2 ± 1	cd 2 ± 1
	d 1.8 ± 0.83	bc 3 ± 0.70	bc 3 ± 1	c 2.6 ± 1.40	cd 2.4 ± 1.34
70:30%	bc 3.2 ± 0.83	c 2.8 ± 0.83	bc 3.2 ± 0.83	cd 2.4 ± 1.14	bc 3.2 ± 1.09
	bc 3.4 ± 0.89	bc 3.2 ± 0.83	cd 2.4 ± 0.54	bc 3.4 ± 0.89	3 ± 1.22
50:50%	c 2.8 ± 0.83	b 3.8 ± 0.44	b 3.8 ± 0.44	c 2.6 ± 0.54	bc 3 ± 0
	cd 2.4 ± 0.89	c 2.8 ± 0.83	cd 2 ± 0.70	c 2.8 ± 1.09	c 2.2 ± 1.30
30:70%	b 3.6 ± 0.89	bc 3.4 ± 0.89	c 2.6 ± 1.14	bc 3 ± 1	c 2.8 ± 1.09
	b 3 ± 0.70	cd 2.4 ± 0.54	c 2.8 ± 0.44	c 2.8 ± 0.83	2.6 ± 0.54
0:100%	bc 3.2 ± 0.83	bc 3.2 ± 0.44	cd 2.4 ± 0.89	cd 2.4 ± 1.40	cd 2 ± 1.22
	bc 3 ± 1.22	bc 3 ± 0.70	cd 2 ± 1	c 2.6 ± 1.14	c 2.8 ± 0.83