ISSN 2250-3153

Effect of Packaging Technique in Physicochemical Composition of Sudanese White Soft Cheese

Muna Ibrahium Abdalla[*], Ibtisam El Yas Mohamed El Zubeir[**], FatimaAlgunaid Hassan[***]

[*] Department fo Food Science and Technology, Faculty of Agriculture, Bakht erruda University, Sudan
[**] Department of Dairy Production, Faculty of Animal Production, University of Khartoum, Sudan
[**] Department of forestry and Range Sciences, Faculty of Agriculture, Bakht erruda University, Sudan

Abstract- Effect of packing technique in chemical composition of Sudanese white soft cheese (SWSC) during storage period investigated. The cheese purchased from Galaja at Edduem,, packed in to 5 different types of packing techniques, 2 metal tin (lined with polyethylene and non-lined), 2 plastic containers (lined with polyethylene and non-lined) and petroleum gallon. Then stored at room temperature (35-37°) for 6 months (180 days) and discharged at 7, 15, 30, 45, 60, 75, 90, 120, 180 days of storage to study changes in physicochemical composition (protein, fat, total solids, salt, ash and acidity). Total solids, protein and fat content of cheese were fluctuating during storage, maximum protein content (30.5%) recorded in lined plastic and tin containers at 60 days of storage. Maximum total solids (53.3) and maximum acidity (2.6% lactic) observed in cheese kept in lined metal tins.

Index Terms- Sudanese white cheese, storage, different packaging materials, physicochemical properties

I. INTRODUCTION

Packaging or packing of cheese is one of the more important steps in the long journey from the producer to the consumer, since most of the cheese plants are far away from the consumption. Packaging of natural cheese must afford general protection of the product from mechanical damage and poor environmental conditions during handling and distribution. Recently, the consumer desire for healthier and safer foods increased. The ultimate goal of the work is to develop packing materials that suit white soft cheese handling and marketing Cheese-making activity in Sudan generally centered in the area between latitudes 12^{o}, 16oN, longitudes 26^{o}, and 36^{o}E, where most of the effective animal wealth of the Sudan found. Within this region, the town of Eddueim is today the most important center for the manufacture of Jibna-beida for commercial purpose. This town alone supplies about 60% of the total cheese on the Sudanese market (Ahmed, 1987). White cheese produced in what called farm-hut plants. These are small, seasonal huts of mud or corrugated, galvanized iron. Each hut has an expanded varandah of wire screens. The huts are scattered around the major town with a distance of about 50 km (Ali, 1987). Cheese making in Sudan is the major preservation method for surplus milk in rural areas especially during rainy season when plenty of milk is available (El Owni and Hamid, 2007; El Owni andHamid, 2008). It is te major type of cheese in Sudan beside Mudaffara and recently Gouda and Mozzarella Introduced (Elsheikh, 1997; Ibrahim, 2008). Sudanese white soft cheese (Jibna beida) traditionally manufactured in different areas in Sudan in which cheese packed in tins, cans and re-used petroleum gallons, which hermetically sealed. Ali and Galal (2002) studied the changes in chemical composition of Domiati cheese as affected by heat treatment,, they found that, the moisture content decreased throughout the storage period from 59.65 at the beginning to 55.9 at the end of the storage period (120 days). the fat, acidity, pH, salt % in water phase found to be 18.2, 0.22, 6.45 and 7.46 respectively at the beginning of the storage period and were changed throughout the storage period to be 20.75, 0.78, 4.9 and 8.41 respectively at the end of storage period. Osman (2005) ;studied the effect of packaging materials (plastic and metal) on the quality of Sudanese white cheese. .She observed that, the cheese stored at room temperature the moisture contents of cheese kept in metal containers significantly ($P < 0.05$.lower than the plastic containers (51.99% for metal and 51.06% for plastic containers) at the end of the storage period (84 days). The ash, fat, protein, pH and titer table acidity found 4.97%, 6.87%, 18.85%, 3.73,1.94 respectively for cheese stored in metal containers .while in plastic container they were found to be 4.13, 6.37, 16.4, 4.14 and 1.93, respectively. The ultimate goal of this study is to investigate the effect of using different packaging techniques on the physicochemical properties of Sudanese white soft cheese

Food materials

The cow milk used in cheese making purchased from nomads at the morning at Galaja village 70 kilometers south Eldueim 350 kilometers southwest of Khartoum. The salt was not of technical grade (from the market). The cheese was prepared according to the traditional methods reported by .The prepared cheese was packaged into 5 different type of packing, 2 metal tin (lined with polyethylene and non-lined), 2 plastic containers (lined with polyethylene and non-lined) and petroleum gallon. The tin containers made from tinplate the inside coated by golden lacquer and the outside was coated by white paint. The tin was square, with push-on-closures and 2 kg size. Plastic containers were white, square, the cover lined with adhesive tape, and 2 kg size. The petroleum Gallon was 2kg size sealed by soldering.

II. METHDOLGY

Analytical procedures

Titratable acidity, total Solids, ash, protein, and fat contents were determined according to AOAC (1990). Salt

content was determined according to a method described by Breen and Price (1961).

Statistical analysis Data generated subjected to Statistical Package for Social Sciences (SPSS, 1998). Means tested using two-factor Analysis of Variance (ANOVA), and then separated using Duncan´s Multiple Range Test (DMRT) according to Mead and Gurnow (1983).

III. RESULTS AND DISCUSSION

Effect of packaging material on Total solids:

Table. 1 illustrates the total solids (T.S.) content of soft cheese as affected by type of packing. After 30 days of storage period, there were no significant differences ($P \leq 0.05$) among cheese samples packed in metal tin, plastic lined with polyethylene bags, and metallic gallon, the higher value observed in cheese samples stored in tin lined with polyethylene bags (53.45%). At the end of the storage period, there were no significant difference ($P \leq 0.05$) between T.S. of cheese samples stored in metal tin cans and those kept in plastic lined with polyethylene bags. The lowest values obtained for T.S. of cheese at day 60 ranged between 39.65 – 40.7%. Our findings were similar to those obtained by Hamid (2005) who found that, total solids content of cheese samples kept in anti-acid cans increased significantly ($P \leq 0.05$) compared to those, kept in plastic containers. Bilal (2000) found that the total solids content of soft cheese samples kept in can were slightly higher compared with those packed in polyethylene bags. The lower total solid content of the cheese samples kept in plastic container attributed to the high moisture content of the cheese, or due to the increased action of proteolytic and lipolytic microflora on the cheese components.

Protein content

Table 2 illustrates the protein content of soft cheese as affected by type of packing. The crude protein contents of cheese samples kept in metal tin cans, plastic and metal gallon container differ significantly ($P \leq 0.05$), however the different types of packaging showed significant variation after 30 days of storage. Similarly the interaction of the processed cheese made after different storage period and different types of packaging showed highly significant differences ($P<0.001$) for acidity of the processed cheese (Table 3). Moreover, the interaction maximum value of 32.00% obtained for cheese samples stored in metallic gallon, followed by tin lined with polyethylene bags and plastic lined with polyethylene bags (31.5%). The lowest values observed in cheese samples kept in metal tin cans and plastic containers (29.5 and 28.5%, respectively). There was a significant difference ($P \leq 0.05$) between the samples kept in the metal tin and those kept in lined metal tin cans at the end of the storage period (180 days). Bilal (2000) reported similar value, of which protein content of the cheese samples packed in polyethylene bags was higher than those packed in anti-acid cans. Hamid (2005) stated that at storage day 120, the protein content of cheese samples kept in cans increased while those in plastic containers decreased. Osman (2005) observed no significant difference ($P \leq 0.05$) in protein content between cheese samples packed in tin and samples kept in plastic packages. The lower protein content of the cheese samples packed in plastic containers attributed to more proteolytic action during the storage (Abdel-Salam, 1987).protein as a result the proteolysis on the one hand, or to the loss in other nutrients on the other. These findings are similar to those reported earlier (Khalid, 1991; AdurKur 1992; Abdel Razig, 1996 and Osman, 2005) where the protein content of soft cheese showed a fall and rise during storage period. Hamid (2005) attributed the decrease in the protein content to the rapid expulsion of whey from the curd

Fat content:

Table. 3 illustrates the changes of fat content of soft cheese as affected by type of packing. The lowest value of fat content of soft cheese was found in cheese samples stored in plastic lined with polyethylene bag (41.39%) at day 30, while the higher value was obtained at day 60 for cheese sample packed in metal tin (74.6%). Significant differences were observed between cheese samples stored in different type of packing throughout the storage period, but they followed the same trends fall and rise. Bilal (2000) and Hamid (2005) reported similar values, they stated that, fat content of the cheese stored in anti-acid cans were higher in comparison with those kept in plastic ones. The low values of fat content of the cheese samples kept in plastic containers might be attributing to the high lypolytic activity. Osman (2005) stated similar results; she observed significant increase ($P \leq 0.05$) in fat of cheese packaged in metal than plastic packages. Similar trend observed by Hofi *et al*. (1976) who reported fat values ranging between 44.54-58.78% when Domiati cheese was stored for 3 months at room temperature .Khalid (1991), Abdalla (1992) and Nuser (2001) stated that the decrease in fat content during storage period was propably due to lipolytic activity of microorganisms on fat. The increase in fat content of soft cheese during storage attributed to the diminution of solids-non-fat content due to the partial degradation of proteins and loss by solubility to whey (Zaki *et al*., 1974; Nofal *et al*., 1981).

Titratable acidity:

Table 4 illustrates changes in titratable acidity of Sudanese soft cheese as affected by type of packing. Titratble acidity of the cheese samples packed in metal cans, significantly ($P \leq 0.05$) lowers than those stored in plastic and metallic gallon. At day 7, at day 60 the acidity of the cheese samples packed in metal tin cans increased significantly than other containers. These result in line with the findings of Bilal (2000) and Hamid (2005). They attributed the increase in acidity of the cheese stored in anti-acid cans; to the activity of lactic acid bacteria which forms considerable level of lactic acid while the low acidity of the cheese samples stored in plastic containers to the growth of yeasts in cheese stored in plastic container, which utilized lactic acid. 0.05).

Ash content:

Table 5 illustrates the changes in ash content of soft cheese as affected by type of packing. The level of ash content in soft cheese was significantly ($P \leq 0.05$) affected by the type of packing. The highest value (12.00%) was found in cheese samples kept in metal tin cans after 7 days of storage, decreased to 8% after 45 days and at day 75 of storage there were no significant

Kept in metal tin, plastic lined with polyethylene bags, metallic gallon and tin lined with polyethylene bags. Hamid (2005) and Osman (2005) reported that ash content of cheese samples kept in anti-acid cans were higher in comparison with those kept in plastic containers. The higher ash content of the cheese kept in anti-acid cans t attributed to the lower moisture content and absorption of salt by the curd (Bilal, 2005).

Salt content:

Table. 6 illustrates the changes in salt content percentage of white soft cheese as affected by type of packaging. The salt content of soft cheese kept in metal tin cans (lined with polyethylene bags and non-lined) significantly ($P \leq 0.05$) higher, (27.4 and 27.2% respectively) than those kept in plastic and metal gallon At day 60, the minimum values were observed in cheese samples kept in plastic, plastic lined with polyethylene bags and metallic gallon (20.7, 18.35 and 17.95% respectively). The lower values of salt content in plastic and gallon packages might be due to high proteolytic activity and decrease in soluble constituents of cheese that results from partial degradation of protein and their subsequent solubility in whey solution. `

V.CONCLUSION

Storage in plastic containers would lead to significant losses in protein and fat. The highest values of total solids observed for samples stored in lined and non-lined tin containers, there for keeping the white soft cheese in tin containers would conserve the nutritive value of it for long storage. Further work i recommended on the keeping quality of the Sudanese white soft cheese stored for longer period longer than 180 days to meet international quality standards.

REFERENCES

[1] Abdalla, O.M. (1992). Effect of proccessing conditions on Microbiological quality of white pickled cheese. Ph.D. Dissertation, University of Tennessec. Knoxville, U.S.A.

[2] Abdel Razig, K.A. (1996). The production of white soft cheese from Different source. M.Sc. Thesis, University of Khartoum, Sudan.

[3] Abdel-Salam, M.H. (1987). Domiati cheese and feta type cheese. In P.G. Fox, (Editor), Cheese. El Sevier Applied Scienc, London, pp. 277-309.

[4] Ador Kur, L.L. (1992). Effect of storage on the quality and chemical composition of Sudanese white soft cheese. M.Sc. Thesis, University of Khartoum. Sudan.

[5] Ahmed, A.M. (1987). The manufacture and packaging of the Sudanese white cheese. Paper presented at the UNESCO, Regional training course on fermented foods of the Arab world. 1-15 Feb. 1987, Food Research Center, Shambat, Sudan.

[6] Ali, M.Z. (1987). Tecknology of cheese making in the Sudan. Paper presented at the UNESCO Regional Training Course on Fermented Foods of the Arab World, 1-15 February. Food Research Center, Shambat, Sudan.

[7] Ali, S.A. and Galal, F.M. (2002). Effect of milk pretreatment on the keeping quality of Domiati cheese. Pakistan J. of Nutrition. 1(3): 132-136.

[8] AOAC (1990). Official methods of analysis, 15th ed.Association of official analytical chemists, Washington, DC, USA.

[9] Bilal, A.M, (1989). Effect of partial Substitution of Soymilk on the chemical composition and sensory characteristics of white soft cheese. M.Sc. Thesis, University of Khartoum. Sudan.

[10] Breen, W.M. and Price, W.V. (1961). Dichloroflouresent and Potassium chromate as indicator in titration test for salt in cheese. J. Dairy Sci., 44: 722-729.

[11] El Owni, A.O.O. and I.A.O. Hamid, 2007. Production of white cheese (Gibna Bayda) in Zalingei area, West Darfur (Sudan). Aust. J. Basic Appl. Sci., 1: 756-762. El Owni, A.O.O. and I.A.O

[12] Hamid, 2008. Effect of storage period on weight loss, chemical composition, microiological and sensory characteristics of Sudanese white cheese (Gibna Bayda). Pak. J. Nutr., 7: 75-80

[13] El-Sheikh, A.N., 1997. Production of Mudaffara cheese from cow's and goat's milk. M.Sc. Thesis, University of Khartoum, Sudan.

[14] Hamid, O.I.A. (2005). Effect of storage on weight loss, chemical composition, microbiological properties and sensory character-istics of white soft cheese. Ph.D. Thesis, Faculty of Animal Production. University of Khartoum, Sudan

[15] Ibrahim, M.N.N., 2008. Effect of manufacturing methods and storage period on characteristics of Mozzarella cheese. M.Sc. Thesis, University of Khartoum, Sudan.

[16] Khalid. A.E. (1991). The effect of salt concentration on the yield and chemical composition of Sudanese white soft cheese. M.Sc. Thesis, University of Khartoum, Sudan.

[17] Mead, B. and Gurnow, R.W. (1983). Statistical Method in Agricultural Nofal, A.; El-hami, M.; Eel-Gazzar, H. and Abu-Elkheir, A. (1981) Studies on the acceleration of manufacturing Domiati cheese. (1). Effect of storage on the yield ad properties of cheese manufactured by the suggested method. Agric. Res. Rev., 59: 301-311.

[18] Osman, E.H.E (2005). The effect of packaging on the quality of Sudanese white cheese. M.Sc., Sudan University of Science and Technology, Sudan.

[19] Nofal, A.; El-hami, M.; Eel-Gazzar, H. and Abu-Elkheir, A. (1981) Studies on the acceleration of manufacturing Domiati cheese. (1). Effect of storage on the yield ad properties of cheese manufactured by the suggested method. Agric. Res. Rev., 59: 301-311.

[20] Nuser, S.N.M. (2001) The Effet of cooked and vaccum Packaging on the Quality of white soft cheese. M.Sc. Thesis, University of Khartoum. Sudan.

[21] Hofi, A.A.; Kabie, A.M.; Farahat, S.E.; Abou-El-Ella, W.M. and El-Shibiny, S. (1976). The yield, quality and chemical composition of Domiati cheese from buffalo's and Soymilk mixture. Egyptian J. Dairy Sci., 4:141-145.

[22] Zaki, M.H.; Metwally, N.H.; Gewaily, E.M.G. and El-Kussy, L.A. (1974). Domiati cheese stored at room temperature as affected by Heat treatment of milk and different salting levels. Agric. R. Rev., 52: 217.

AUTHORS

First Author – Muna Ibrahium Abdalla, Department fo Food Science and Technology, Faculty of Agriculture, Bakht erruda University, Sudan, E-mail: muaiibrahim@gmail.com
Second Author – Ibtisam El Yas Mohamed El Zubeir, Department of Dairy Production, Faculty of Animal Production, University of Khartoum, Sudan
Third Author – FatimaAlgunaid Hassan, Department of forestry and Range Sciences, Faculty of Agriculture, Bakht erruda University, Sudan

Table 1: Changes of total solids of white soft cheese during storage period as affected by type of packaging*

Packaging Type	Storage period (days) 0.0	7	15	30	45	60	75	120	150	180
MT	50.150^{a-e}	43.900^{a-g}	44.600^{a-f}	52.050^{a-e}	51.100^{a-e}	40.200^{c-g}	50.450^{a-e}	50.350^{a-d}	50.300^{a-d}	53.350^{a}
MTL	50.150^{fg}	48.150^{a-e}	47.350^{a-e}	53.450^{a}	52.750^{ab}	39.650^{e-g}	53.300^{a}	53.200^{a}	32.150^{a-h}	52.250^{a}
P	50.150^{a-e}	43.400^{a-g}	45.300^{a-f}	51.300^{a}	51.150^{a-e}	40.700^{b-g}	51.250^{a-e}	52.200^{a-d}	51.700^{a-d}	45.730^{a-d}
PL	50.150^{a-e}	43.150^{a-g}	44.200^{a-f}	52.000^{a-e}	52.550^{a-c}	40.050^{d-g}	52.200^{a}	47.760^{a-f}	47.760^{a-f}	47.760^{a-f}
MG	50.150^{a-e}	46.600^{a-f}	47.150^{a-f}	50.550^{a-e}	51.600^{a-e}	40.250^{c-g}	52.150^{a-e}	48.350^{a-e}	48.350^{a-e}	48.350^{a-e}

* Mean values having different superscript letters in columns and rows differ significantly ($P \leq 0.05$).

Where:

MT = Metal tin

MTL = Metal tin lined with polyethylene bags

P = Plastic

PL = Plastic lined with polyethylene bags

MG = Met

Al gallon

Table 2: Changes in protein content (%) of white soft cheese during storage period as affected by type of Packaging* (on dry matter basis)

Packaging	Storage period (days)									
Type	0	7	15	30	45	60	75	120	150	180
MT	28.50^{c}	27.00^{f}	28.50^{c-g}	23.00^{l-n}	26.00^{hij}	29.50^{b-e}	25.00^{i-l}	29.00^{c-f}	26.60^{f}	27.30^{e}
MTL	28.50^{c}	27.00^{f}	28.50^{c-g}	22.00^{no}	27.50^{d-h}	31.50^{ab}	23.50^{k-n}	23.50^{k-n}	25.10^{h}	29.80^{a}
P	28.50^{c}	29.00^{c}	30.50^{a-c}	22.50^{mn}	27.00^{f-i}	28.50^{c-g}	20.00^{o}	20.00^{o}	26.55^{f}	25.80^{h}
PL	28.50^{c}	29.00^{c}	31.50^{ab}	21.50^{no}	27.00^{f-i}	31.50^{ab}	24.50^{j-m}	24.50^{j-m}	27.30^{e}	27.30^{e}
MG	28.50^{c}	27.50^{d}	30.00^{a-c}	25.50^{h-k}	26.50^{g-j}	32.00^{a}	16.50^{p}	16.50^{p}	25.40^{h}	25.40^{h}

* Mean values having different superscript letters in columns and rows differ significantly ($P \leq 0.05$).

.

Table 3: Changes in fat content (%) of white soft cheese during storage period as affected by type of packaging* (on dry matter basis)

Packaging	Storage period (days)									
Type	0	7	15	30	45	60	75	120	150	180
MT	46.15^{pq}	54.05^{i-l}	53.75^{j-l}	42.20^{rs}	60.65^{c}	74.60^{a}	60.10^{cd}	53.60^{j-l}	54.60^{g-l}	57.15^{e}
MTL	46.15^{pq}	47.75^{op}	50.65^{mn}	43.95^{qr}	56.80^{e-i}	70.40^{b}	56.10^{f-k}	55.40^{f-l}	52.70^{lm}	58.30^{c}
P	46.15^{pq}	55.20^{g-l}	52.95^{lm}	44.80^{qr}	57.50^{d-g}	70.00^{b}	59.45^{cde}	55.50^{f-l}	55.05^{g-l}	55.20^{g}
PL	46.15^{pq}	54.25^{h-l}	53.15^{k-m}	41.30^{s}	54.20^{h-l}	69.85^{b}	60.30^{c}	54.20^{h-l}	54.20^{h-l}	54.20^{h}
MG	46.15^{pq}	53.60^{j-l}	49.80^{no}	48.45^{n-p}	56.30^{f-j}	72.05^{b}	55.55^{f-l}	54.60^{gl}	54.60^{g-l}	54.60^{g}

* Mean values having different superscript letters in columns and rows differ significantly (P≤ 0.05).

Table 4a: Changes in the acidity of white soft cheese during storage period as affected by type of packaging*

Packaging	Storage period (days)									
Type	0.0	7	15	30	45	60	75	120	150	180
MT	0.725^{q}	1.200^{op}	1.400^{no}	1.550^{no}	1.750^{h-k}	2.100^{c-g}	2.200^{g-k}	1.950^{b-f}	2.150^{d-i}	2.490^{a-b}
MTL	0.725^{q}	1.100^{p}	1.450^{m-o}	1.500^{l-n}	1.950^{i-k}	2.400^{d-i}	2.050^{f-j}	2.150^{e-i}	2.350^{b-f}	2.660^{a}
P	0.725^{q}	1.300^{n-p}	1.500^{l-n}	1.400^{m-o}	1.900^{i-k}	2.200^{d-i}	1.950^{e-i}	2.250^{l-n}	2.100^{l-n}	1.700^{k-m}
PL	0.725^{q}	1.350^{n-p}	1.450^{m-o}	1.500^{j-l}	1.850^{d-i}	2.100^{c-g}	2.000^{g-k}	2.050^{c-h}	2.320^{a-b}	1.710^{k-m}
MG	0.725^{q}	1.400^{no}	1.450^{m-o}	1.430^{g-k}	1.850^{bc}	2.100^{e-i}	2.050^{c-h}	1.570^{b-c}	1.570^{l-n}	1.570^{l-n}

* Mean values having different superscript letters in columns and rows differ significantly ($P \leq 0.05$).

Table 4b: Changes in ash content (%) of white soft cheese during storage period as affected by type of packaging* (on dry matter basis)

kaging	Storage period (days)									
	0	7	15	30	45	60	75	120	150	180
	10.00^{cd}	12.00^{a}	10.00^{cd}	10.00^{cd}	8.000^{fgh}	10.00^{cd}	7.500^{gh}	8.500^{efg}	8.500^{efg}	7.500^{gh}
L	10.00^{cd}	10.00^{cd}	9.000^{def}	9.500^{cde}	7.500^{gh}	9.500^{cde}	7.500^{gh}	7.500^{gh}	7.500^{gh}	8.000^{fgh}
	10.00^{cd}	11.50^{ab}	10.00^{cd}	10.00^{cd}	8.500^{efg}	10.50^{bc}	8.000^{fgh}	7.500^{gh}	8.000^{fgh}	9.150^{cd}
	10.00^{cd}	11.50^{ab}	10.00^{cd}	9.500^{cde}	8.000^{fgh}	10.50^{bc}	7.500^{gh}	10.00^{cd}	10.00^{cd}	10.00^{cd}
	10.00^{cd}	10.00^{cd}	9.000^{def}	9.500^{cde}	7.000^{h}	10.00^{cd}	7.500^{gh}	9.000^{def}	9.000^{def}	9.000^{def}

* Mean values having different superscript letters in columns and rows differ

Table 5: Changes in salt content (%) of white soft cheese during storage period as affected by type of packaging* (on dry matter basis)

Packaging	Storage period (days)								
type	0	7	15	30	45	60	75	120	150
MT	12.60^{mn}	14.25^{i}	6.950^{q-s}	8.750^{o-r}	19.60^{cd}	27.20^{a}	17.00^{e}	16.55^{e}	16.30^{e-j}
MTL	12.60^{mn}	12.75^{l}	5.950^{s}	9.150^{o-q}	15.25^{h-k}	27.40^{a}	17.00^{e}	15.85^{f}	14.60^{i-m}
P	12.60^{mn}	15.15^{h}	7.350^{p-s}	9.450^{op}	17.80^{d-g}	20.70^{c}	15.55^{g}	15.95^{f}	12.60^{mn}
PL	12.60^{mn}	14.90^{h}	7.900^{p-s}	10.55^{no}	18.40^{de}	18.35^{de}	14.50^{i}	13.90^{j}	13.90^{j-m}
MG	12.60^{mn}	13.40^{k}	6.700^{rs}	9.400^{op}	22.95^{b}	17.95^{d-f}	14.25^{i}	13.90^{j}	13.90^{j-m}

* Mean values having different superscript letters in columns and rows differ significantly ($P \leq 0.05$).