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INTERACTION OF NUTRITION SOLUTION AND VOLUME ON SECONDARY METABOLITE OF GERMAN CHAMOMILE IN HYDROPONICS SYSTEM

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Abstract:

In order to investigate the interaction of nutrition solution and volume on secondary metabolite of German chamomile in hydroponics system an experiment was conducted at research field at Khorramabad-Lorestan, Iran. Green house experimental was carried out by factorial design as a complete block randomized with 4 replications. Factors studied included four nutrition solutions (Hogland, Shnider, Cooper and suggested solution by researcher) and Hydroponic volumes were Coocoopit, sand+Perlit, Coocoopit+Perlit, Coocoopit+sand+Perlit.The results showed that nutrition solution and hydroponic volumes had significant effect on secondary metabolites. Means comparison showed that the highest percentage of Chamazulene was obtained with 3.62% from L2F2 and the lowest percentage with 2.73% was obtained from L2F1. Also the highest β-Bisabolol with 9.55% was obtained from L1F4 and lowest β-Bisabolol with 6.21 was obtained from L3F1. Results showed that the amounts of hydroponic volume and nutrition solution had significant effect on quantitative and qualitative yield of chamomile plant and the crowded production can be achieved with management of atmospheric conditions. Results showed that chamomile plant react differently to different volumes as the highest yield in flower number was obtained from L1 volume but the highest yield of Chamazulene and β-Bisabolol was obtained from L2 volume**.**

Key Word: Nutrition Solution, Volumes, Secondary Metabolites, German Chamomile, Hydroponics

Introduction: Matricaria chamomilla has considerable medicinal value among chamomile in different species. Chamomile is one of oldest medicinal plants recognized by human (Hornok, 1992).The flower of chamomile contain 1-

2% volatile oil including alpha bisabolol oxide A & B, and matricin (usually converted to chamazulene) and other flavonoids which possess anti inflammatory and anti phlogiston properties. A study in human volunteers demonstrated that chamomile flavonoids and essential oil penetrate below the skin surface into the deeper skin layers. This is important for their use as topical anti phlogiostic (anti-inflammatory) agents. Flowers essence of this plant has anti microbe effect and it is used in food, makeup, health and pharmacy industries (Omidbeigi, 2008).Climate condition has important role in growth, development and shape of chamomile. Chamazulene, Bisabolol, Pharenesene and its oxides are recognized as the most important compounds among essence compounds of chamomile, and it is because of their anti-inflammatory properties (Alikhani, et al., 2011). Essential oils which contain high amount of Bisabolol and chamazulene are recognized as well-qualified ones (Omidbeigi, 2008). Medicinal plants cultivation is one of the most important branches of agricultural studies which are applicable in extracting and producing ingredients in order to produce drugs (Azizi, 2011). At the beginning of present century, due to the advancements in Chemistry science and detection of complicated systems, the organic synthesis resulted in progress the medicinal industry by replacing of Chemotherapy (Velag, J., J. Stodla, 2008). In this manner modern medicine has cured many incurable and deadly diseases (Velag, J., J. Stodla, 2008). Essence percent is increased with increasing elements of the volume of chamomile (Rahmati, et al., 2008). Application of nitrogen keeps chamomile longer in most young physiological stages and it increases essence and bisabolol amounts. Nitrogen is the main part of amino acid and protein which has basic role in growth and development of the plant. Among necessary elements, the effect of nitrogen is more observed during plant growth compared to other necessary elements. It is because its shortage has effect on plant's growth, crop amount and crop quality. Phosphorus has the main role in energy transfer system, so phosphorus shortage causes decrease in its growth. Phosphorus is an element which has more important role in the plant reproductive part and it is an important element in German chamomile. More physiologists believed that potassium is necessary for protection and balance of ion and also in making and movement of carbohydrate, but its peculiar role is not distinct. Chamomile plants will keep younger in physiological stage with Application of nitrogen fertilizer and it will increase essence and Bisabolol amount (Franz, Ch., 1983). He also stated that nutrition has effect on effective materials indirectly. One of most important factors in hydroponics cultivation is the type of nutrition solution which is available for plants. In this test, four nutrition formulas were used so that nutrition in formula F1 (Hogland) was the highest efficiency of mean comparison table among only two traits (extract efficiency and Quercetin).

So it shows that, this formula is not an optimal formula for Chamomile. Formula F2 (Shnider) was the highest efficiency (dry weight of flower, farenzen, essence weight and essence efficiency) and formula F4 was the highest efficiency of mean comparison table in four traits (wet weight of flower, farenzen, Chamazulene, β-Bisabolol). The best nutrition formula was nutrition formula F3 (Cooper) which was used in this test and it was with the highest efficiency from 20 traits measured in means comparison table. Also essence is increased with increasing nitrogen and phosphorus fertilizer and it is decreased with increasing potassium. Nitrogen is effective in biosynthesis of essence and it can be effective in quality and quantity of essence (Franz, 1983).

Material and Methods

This test was conducted in Neginsabz Green house, located in Daraei village at Khorramabad, Lorestan, Iran between 2010 and 2012. Field experimental was carried out by a completely blocked randomized with 4 replications. In this test, the used seed is from modified German chamomile. The factors were four hydroponic mediums (1.cocopit 2. Sand+perlit 3.Cocopit+perlit4.Cocopit+sand+perlit) and four solution nutritions (Hogland, Eshnider, Cooper, My solution). The seeds were planted in February. Flowerpot were filled with different hydroponic mediums according to test plan and they were kept next to each other. After budding of seeds, they were scattered florets and 4 florets were kept in each flowerpot. Nutrition solution was given to flowerpot according to test plan. Flowers sampling was done 65 days after cultivation. Plant different body parts, including flower, leaves and stems, were dried in shadow then they were broken and kept in laboratory environment, away from light. Extraction of essential compounds was done by PDMS fiber through UA-HS-SPME method.

The method used for sampling analysis was from optimum condition by Professor Ghiasv and colleague (Table2). (*Ghiasvand*, *et al*., 2011). After identifying the extracted volatile compounds from cultivated chamomile in hydroponic system by compounds mass spectrums and their comparison with standard spectrum (NIST) on GC/Ms machine, the existing compounds were accumulated with basis on line temperature program (LTPRI) and line alkenes C8-C20in order to identify and compound the quantity measurement more exactly. Laboratory stages were done at laboratories of medicinal plants research center of Lorestan- Iran and Chemistry Faculty of Lorestan University. Obtained information was analyzed with statistical program of Mstat C and the means were compared to Duncan test.

Results

Results of variance analysis showed that interaction of nutrition solution and volume had a significant effect on Farenzene in 1% level (table 2). Means comparison showed that the highest Farenzene was obtained from L3F2 with 86.42% and the lowest Farenzene percent was obtained from L1F1 with 79.42% (chart 1).

Results of variance analysis showed that interaction of volume and nutrition solution was significant in Chamazulen in 1% level (table 2). The highest Chamazulen percent was obtained from L2F2 with 3.62% and the lowest Chamazulen percent was obtained from L2F1 with 2.73% (Chart 2). Flower number will increase by increasing the nitrogen fertilizer and phosphorus. Also more Chamazulen will be produced with increasing this element (Dadkhah and colleague 2000).

Results of variance analysis showed that interaction of nutrition solution and volume was significant in 1% level (table 2). The highest Bisabolol was seen in L1F4 with 9.55% and the lowest bisabolol was seen in L3F1 with 6.21% (chart 3).

Results of variance analysis showed that interaction of volume and nutrition solution on Germacrene was significant in 1% level (table 2). The highest Germacrene percent was obtained from L3F3 with 3.65% and the lowest Germacrene percent was obtained from L1F2 with 2.76% (Chart 4).

Results of variance analysis showed that interaction of nutrition solution and volume on Epigenin was significant in 1% level (table 2). The highest Apigenin percent was seen in L4F3 with 1.75% and the lowest Apigenin was observed in L4F2 with 0.8% (Chart 5).

Conclusion

The results showed that the kind of hydroponic volume and nutrition solution had significant effect on quality and quantity yield of chamomile plant and with management of environmental condition, it can arrive at a high production. According to the results, effect of year had changed minimum on crop yield of chamomile and significant change was not observed in treatments except in chamazulen percentage which, by these results it became clear that there were the same environmental condition, hydroponic volume and nutrition solution in the period of2 years. The test showed that chamomile plant had different reactions on different hydroponic volume as the highest yield of Farenzen and Germacrene-D was obtained in coocoopit+Perlit and the highest yield of Chamazulene and β-bisabolol was obtained in Sand+Perlit. Also the highest yield of Farenzene was obtained in Eshnider nutrition solution and the highest yield of β-bisabolol was obtained in the solution made by the researcher. An important factor in hydroponic volume is the kind of

nutrition solution which is given to the plant. Four nutrition formulas were used in this test among which F4 nutrition formula (made by the researcher) had the highest yield in Farenzene, Chamazulene and β-bisabolol between other nutrition formulas. The results of means comparison showed that the highest yield of volume interaction and nutrition solution were obtained brom L3F3 and L4F3 because they had the best volume and nutrition solution among other treatments. Means comparison showed that the highest yield of Farenzene was obtained from interaction of L3F2 and the highest Germacrene was observed from L3F3. So, according to obtained results, the volume of Coocoopit+Perlitin cooper nutrition solution can be the best condition for Chamomile planting in green house condition. Keeping the ability of water and nutrition solution in Coocopit volume and more amount of nutrition in Cooper solution is one of the main reasons of the production high efficiency.

Climate condition has the main role in chamomile growth and even its formation. In case chamomile growth in salt and unfertilized land, it produced a short plant (with height of 5 cm) with small and fine flowers. According to the researches done in Iran and other countries, it is shown that there are more differences between the viewpoint of quality and quantity of effective materials and between different spices of chamomile that is grown in different climate conditions. The essence of some species has more amount of Chamazulen whereas some species lack this. The amount of flower essence is different and it depends on the climate condition of its growing place and it should be between 0.4 and 1.5 percent. From 12 to 20 percent of essence is formed by Chamazulen and it has effective role on swelling treatment (*Jafarnia and Velag*, 2008).

Environmental condition and stresses are effective in the amount of effective compounds (*Sharafzadeh*, 2011). Chamomile stays that younger in physiological stage with the application of nitrogen fertilizer and essence and Bisabolol amount have increased (*Morad*, 2009). Also Franz believes that essence amount increases with increasing nitrogen and phosphorus fertilizer and it decreases with application of potassium fertilizer.

Continuous presence of nutrition elements and the same phosphorus, with their main role in plant reproductive process, can increase yield of German chamomile plant from view points of quantitative (flower dry weight per unit area) and qualitative (flower essence amount and effective material percent of essence) (*Sanavi et al*., 2011). Reportedly, the amount of α-bisabolol and its oxide is 78% and the amount of Chamazulenis 1-15% (*Gupta et al*., 2010). In this research, the maximum of α-bisabolol and Chamazulen were obtained respectively (with 9.4% and 3.7%) from hydroponic volume

of Coocoopit and private nutrition solution and hydroponic volume of sand+perlit and nutrition solution of Eshnider. The highest compound in chamomile extract is α-bisabolol oxide A and α-bisabolol oxide B (*Shams-Ardakani et al*., 2006). According to researches, the minimum and maximum amounts of α-bisabolol reported are 6.3% and 9.4% as it is observed in the diagram.

Treatments of sand+ Perlit and private nutrition solution show similar results in view of β-bisabolo amount. These treatments have the best yield then we can suggest them as the best nutrition solution and the best hydroponic volume. Climate condition during the years is another factor that has a main role in flavones accumulation in tissues.

Environmental stresses and light intensity are also effective in increasing flavones amount. Flavones amount were under the effect of hydroponic volume kind and nutrition solution and also an increase in the amount of the compound was observed in some volumes and nutrition solutions.

Table-1: Table of the elements in the nutrient solution used by the researcher.

Calcium nitrate	28 ppm
Potassium nitrate	14 ppm
Potassium mono phosphate	7.734 ppm
Magnesium sulfate	9 ppm
Manganese sulfate	0.3 ppm
Copper sulfate	0.05 ppm
Zinc sulfate	0.2 ppm
Boric acid	0.15 ppm
Fe	0.9 ppm
PH	6.5-7
Temperature	12-25 ºC

Table-2: Means comparison of hydroponic volume and nutrition solution on matricaria chamomile.

Treatments	means comparison			
	β-Bisabolenol	*Chamazulene*	*Germacrene-D*	Pharenzen Apigenin
Year				
Year 1	8.00[a]	3.12[b]	3.09[a]	83.61[a] 1.13[a]
Year 2	7.92[a]	3.41[a]	3.31[a]	84.04[a] 1.31[a]
		Hydroponic Volume		
Cocopit(L1)	8.217[a]	3.14[a]	3.00[c]	82.63[b] 1.21[a]
Sand+Perlit(L2)	8.327[a]	3.18[a]	3.09[b]	82.67[b] 1.14[a]
Cocopit+Perlit(L3)	7.31[c]	3.01[b]	3.18[a]	85.07[a]

				0.99[b]
Cocopit+Sand+Perlit(L4)	7.987[b]	3.15[a]	3.15[a]	84.93[a]
				1.15[a]
Nutrition Solution				
Hogland(F1)	7.19[c]	3.00[c]	3.10[b]	81.45[b]
				1.27[b]
Eshnider(F2)	7.25[c]	3.22[b]	2.89[d]	84.73[a]
				0.85[d]
Cooper(F3)	8.18[b]	2.90[d]	3.45[a]	84.6[a]
				1.46[a]
My Solution(F4)	9.21[a]	3.35[a]	2.98[c]	84.52[a]
				0.91[c]
Hydroponic Volume × Nutrition Solution				
Cocopit× Hogland	7.10[g]	3.41[b]	2.89[ef]	79.42[g]
				1.22[cd]
Cocopit× Eshnider	7.40[f]	2.96[de]	2.76[g]	85.66[ab]
				0.95[fg]
Cocopit× Cooper	8.82[c]	2.93[de]	3.30[b]	83.36[d]
				1.56[b]
Cocopit× My Solution	9.55[a]	3.28[c]	3.04[cd]	82.06[e]
				1.10[de]
Sand+Perlit× Hogland	8.00[de]	2.73[g]	3.15[c]	81.31[ef]
				1.59[b]
Sand+Perlit× Eshnider	8.04[de]	3.62[a]	2.83[fg]	80.91[f]
				0.84[gh]
Sand+Perlit× Cooper	7.97[de]	2.88[ef]	3.42[b]	84.84[bc]
				1.27[c]
Sand+Perlit× My Solution	9.30[ab]	3.47[b]	2.94[def]	83.62[d]
				0.87[gh]
Cocopit+Perlit× Hogland	6.21[h]	2.97[de]	3.39[b]	83.48[d]
				1.07[ef]
Cocopit+Perlit× Eshnider	6.48[h]	2.88[ef]	2.86[efg]	86.42[a]
				0.81[h]
Cocopit+Perlit× Cooper	7.77[e]	2.99[d]	3.65[a]	84.21[cd]
				1.26[c]
Cocopit+Perlit× My Solution	8.78[c]	3.19[c]	2.84[fg]	86.17[a]
				0.83[gh]
Cocopit+Sand+Perlit× Hogland	7.46[f]	2.89[def]	2.97[de]	81.59[ef]
				1.18[cde]
Cocopit+Sand+Perlit× Eshnider	7.10[g]	3.41[b]	3.10[c]	85.92[a]
				0.80[h]
Cocopit+Sand+Perlit× Cooper	8.17[d]	2.82[fg]	3.42[b]	85.99[a]
				1.75[a]
Cocopit+Sand+Perlit× My Solution	9.22[b]	3.47[b]	3.10[c]	86.24[a]
				0.85[gh]

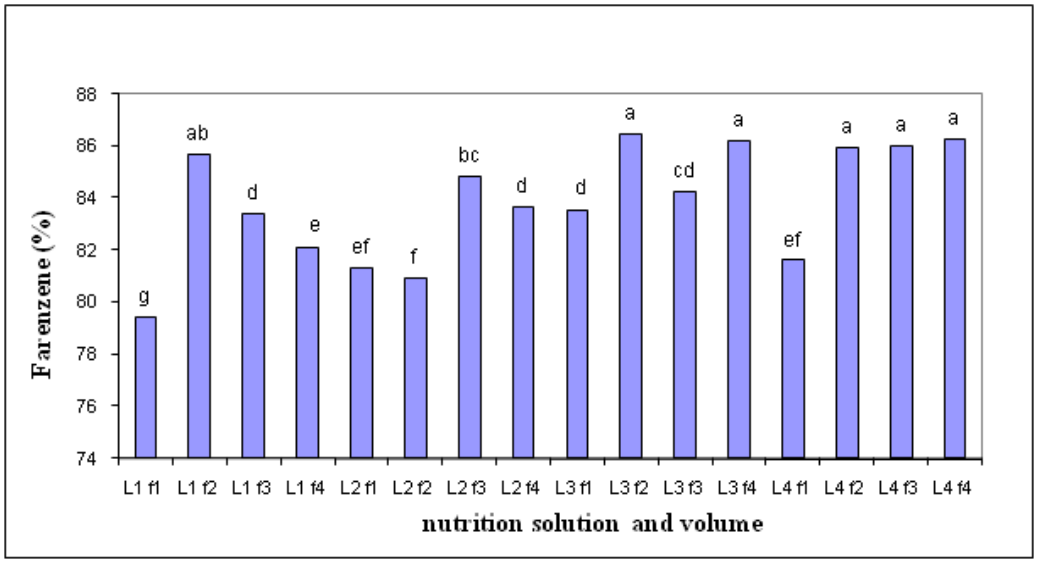

Chart-1: Interaction of nutrition solution and volume on Farenzene percent.

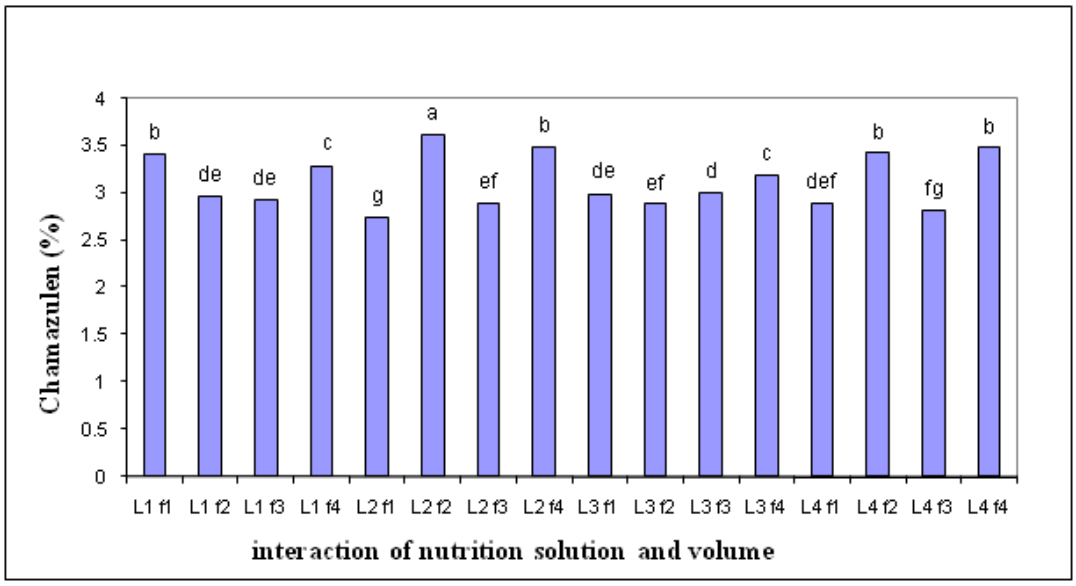

Chart-2: Interaction of nutrition solution and volume on Chamazulen.

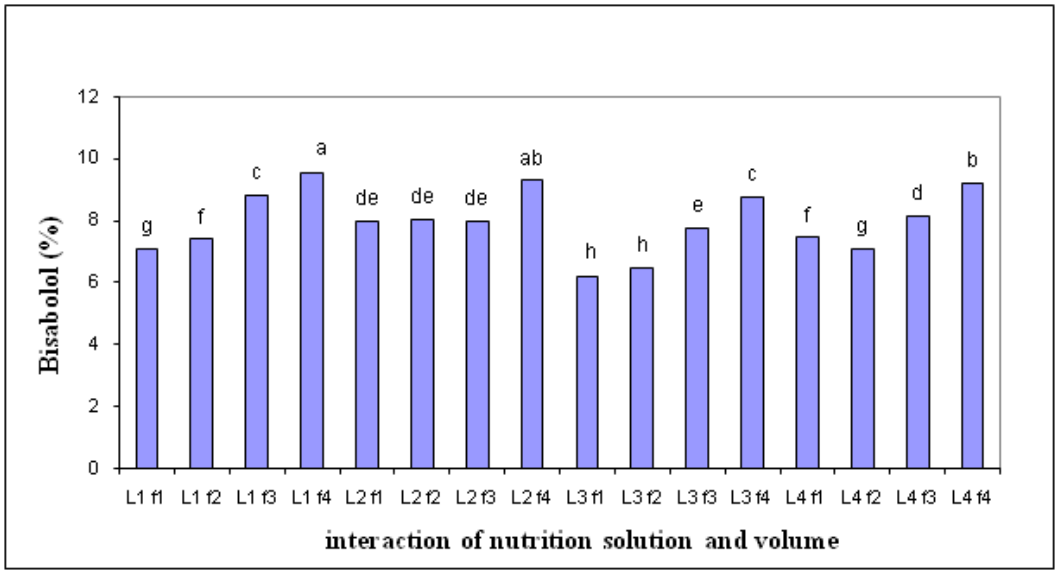

Chart-3: Interaction of nutrition solution and volume on bisabolol.

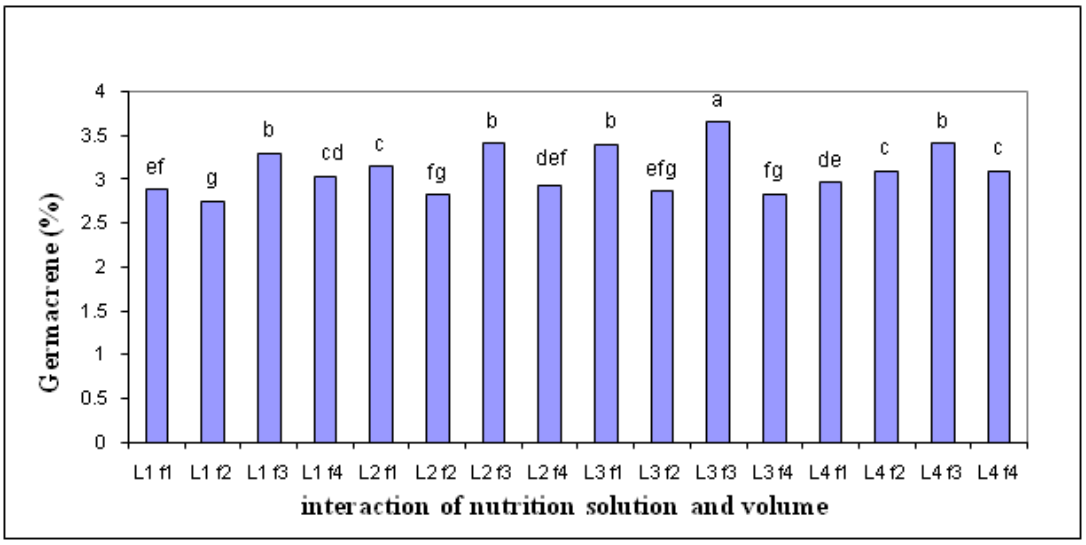

Chart-4: Interaction of nutrition solution and volume on Germacrene.

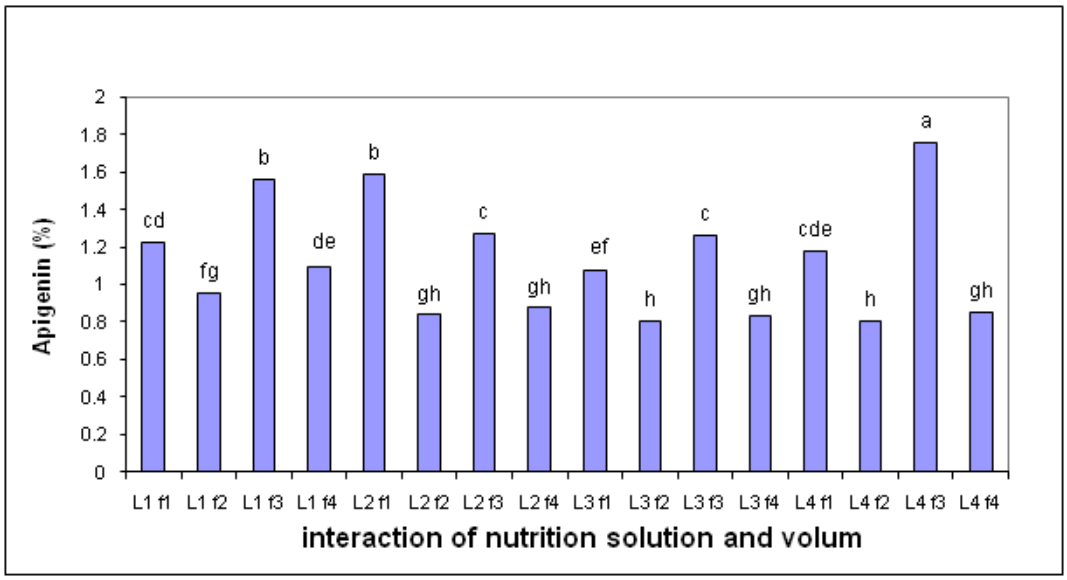

Chart-5: Interaction of nutrition solution and volume on Apigenin.

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