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COMPARATIVE STUDY BETWEEN SOME SYSTEMS OF MIXING AND PROCESSING FEED ADDITIVES AND CONCENTRATED

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ABSTRACT: The main experiments were carried out in a local factory for manufacturing feed additives and concentrated in El-Obour city, Kalubia Governorate to study the effect of some operating parameters on the performance of two mixing units. Experiments were carried out using both big mixer and small mixer under four different effective Batch sizes, four different mixing times and three different carrier materials. Evaluation of the performance of the two mixers was carried out taking into consideration the mixer productivity, homogentity, coefficient of variation, energy requirements, and mixing cost.

The obtained results reveal to the following:

- The big mixer is recommended to be used for producing feed additives under the following conditions:

1. Batch size of between (1000 and 1200 kg).
2. Mixing time of between (10 and 15 min).
3. Carrier material: mixture of calcium carbonate and corn gluten Ratio 3:1

- The small mixer is recommended to be used for producing feed additives under the following conditions:

1. Batch size of between (200 and 250 kg).
2. Mixing time of between (40 and 60 min).
3. Carrier material: mixture of maltodextrin and sucrose ratio 1:1.

Key words: Mixing, feed additives, homogeneity, cost.

INTRODUCTION

Manufacture of compound feed additives means at first homogeneous mixing of extremely small parts of additives (micro components) into large quantities of feed mixture components. The objective of the mixing process is to produce feed additives in which nutrients and medication are uniformity distributed. And well mixed. Therefore, mixing is one of the essential technological processes for production of compound feed additives for animals and it has important influence on the quality of the final product .Feed additives are a substance added to feed in micro quantities to fulfill specific nutritional need essential nutrients in the form of amino acids, vitamins, and minerals. the different stages of mixing or processing carried out according to written procedures which define ,control and check the critical points in process in order to an acceptable level without any hazards to human or animal health. The problems are the addition and homogeneous distribution of the micro components (additives), the stability of this final mixture and the avoidance of concentration losses and carry-over of the additives in the total production plant. The mixing technology will be evaluated by the so-called working accuracy of the production plant, which is different from the mixing efficiency of the mixer. This efficiency of the mixer will be expressed by the homogeneity obtained after different or usual mixing time for the used mixer and material composition .the homogeneity of the mixture after the usual mixing time and after conveying the mixture to the final station expressed by the coefficient of variation. Duncan (1973) studied the effects of nutrient uniformity (or lack of) on broiler performance. He found that the lack of dietary crude protein uniformity affected broiler chick performance negatively as a function of protein consumption. Intuition suggests similar results on animal performance would be attained with decreasing mix uniformity. Dirksen *et al.* (1980) mentioned that stationary mixing equipment is available commercially. A batch mixer to prepare separate batches of feed is a practical system. On-farm feed systems normally use three types of mixers: vertical, horizontal, or rotating drum. Vertical mixers take up the least floor space and have the greatest height requirement. Mixing times on vertical mixers normally run 10 to 15 min. Horizontal and rotating drum mixers can mix in 5 to 10 min. either type will do a satisfactory mixing job for farm use. The vertical mixer is composed of an upright tank, usually round, with a vertical auger in the center to mix the feed. Smaller, less costly mixers are usually of the vertical type. Typical vertical mixers are available in models ranging in size from a 1/2-ton model requiring a 3-horsepower motor up to a 4-ton model requiring a 25-horsepower motor. Larger mixers are usually of the horizontal type with a horizontal shaft in the center carrying paddles or ribbons for the mixing. Power requirements range from 3 to 5 horsepower for an 1/2-ton mixer up to 20 to 30 horsepower for a 3-ton model. Wicker and Poole (1991) introduced a program to monitor uniformity of feeds manufactured by customers using their amino acid and other products Their results would indicate that only about half of the feeds tested would be of satisfactory uniformity (C.V. < 10%). About 30% had a C.V. of 10-20% and the remaining 20% of the feed samples had a C.V. of > 30%. It is not known precisely at what level of uniformity animal performance will be affected, but one can certainly assume that at a C.V. of greater than 20%, performance would be decreased. They reported also that mixing a 6 ton batch of feed in a typical "5-ton"mixer were unable to reduce the C.V. Below 29.8 % even as mixing time was increased (using synthetic methionine and lysine as markers). Once the batch size was reduced to five tons in the same mixer, mix uniformity (C.V.) improved dramatically from 34.6% to 2.6% and 12.0% to 4.6% as mix time was increased (synthetic methionine and lysine as markers, respectively).

Stark *et al.* (1999) conducted a study similar to that of Wicker and Poole except using salt as the tracer rather than synthetic amino acids. The results tended to about 42% of the samples having a C.V. of < 10%, 46% between a C.V. of 10% and 20% and 12% having a C.V. of > 20%. It is apparent that, at least in a significant portion of feed produced, nutrient uniformity criteria are not being met. Traylor (1997) conducted a 21day growth assay with weanling pigs with mix time treatments of 0, 0.5, 2, and 4 min in a double-ribbon mixer. Increasing mix time 0.5 min decreased the C.V. for Cr (chromic oxide was the marker used in this experiment) concentration from 107 to 28% Diet uniformity was improved further as mix time was increased to 4 min (i.e., a C.V. of 12%). Rate and efficiency of gain increased markedly as mixing time was increased 0.5 min, with little response to increasing mixing time further to 4 min. The ASAE (1997a,b) secretariat has identified a number of methods of on-farm feed mixing which are available to livestock farmers. It appears that on-farm mixing of feeds is most likely to be practiced on those farms where there are opportunities to use home-produced cereals and forages. Mixer wagons (mobile equipment for producing complete diet feeds or "total mixed rations" are more likely to be used on mixed arable and livestock farms or farms that grow a number of different grass crops, rather than all-grass farms. Chaudeur (2003) a theoretical definition of the 'robustness' of a powder mixture based on knowledge of the quality of a mixture before and after a segregation test. Specific attention is paid to the problem of homogeneity estimation through sampling. A simple static segregation device, specially developed for this study, is then used for evaluating the robustness of pharmaceutical powder mixtures. The effect of using an recipient, of the same chemical nature but different physical properties, is investigated from the point of view of size and shape of the particles, it is found that particle size has practically no influence on robustness, but it is demonstrated that particle shape has an important effect. Replacing irregular-shaped particles in a powder mixture by spherical-shaped particles (such as those produced by spray-drying) can provide a dramatic disruption of the structure of a mixture by a simple pouring. The static segregation device is used as a relative measurement of homogeneity of complex blends consisting of animal feed and aroma. The evaluation of the effect of a premix step leads to the conclusion that the process time devoted to premixing should be optimized with respect to the overall mixing.

The objectives of this study are:

- Evaluating the performance of two types of mixing and processing feed additives and concentrated units.

-Optimizing some operating parameters affecting the performance of the used mixers (mixing Time, carrier materials and batch size,).

-Measuring the energy requirements for operating the used mixers.

- Comparing the mixers used from cost analysis.

MATERIAL AND METHODS

Materials

The main purpose of this study is to evaluate the performance of two mixing units during mixing and processing feed additives and concentrated.

Experimental ration for BUHLER (big mixer) is tabulated in Table 1 while experimental ration for RIBBON (small mixer) is tabulated in table (2).

Mixing units

Two mixing units called BUHLER (big mixer) and RIBBON (small mixer) were used in this study Figs. 1& 2. Both mixers consist of the following main parts: feeding hopper, feeding screw, mixing body, out put gate and electric motor 30 KW/hr

Methods

The main experiments were carried out in a local factory in El-Obour city, Egypt to study the effect of some operating parameters of two mixing units.

Experimental Conditions

The two mixing units were examined as a function of change in the following parameters:

- Batch size of 600, 800, 1000 and 1200 kg for the BUHLER (big mixer).
- Batch size of 100, 150,200, and 250 kg for the Ribbon (small mixer)
- Mixing times of 5, 10, 15 and 20 min for BUHLER (big mixer).
- Mixing times of 30, 40, 50 and 60 min for the Ribbon (small mixer).

Carrier Materials

For BUHLER (big mixer): Corn gluten, and calcium carbonate, calcium carbonate only corn gluten only.

For Ribbon (small mixer): Maltodextrin and sucrose, Maltodextrin only, and sucrose only.

Performance Indicators

The performance of the two mixers was evaluated taking into consideration the following indicators:

Table 1. Experimental ration for BHULER (Big mixer) using carrier corn gluten and calcium carbonate 1:3 taken from adwia s.o.p

Composition	Batch size, kg			
	600	800	1000	1200
Vitamin A 500,000 I.U/mg	12	16	20	24
Vitamin D3 500,000 I.U/mg	2.4	3.2	4	4.8
Vitamin E 50%, Kg.	2.4	3.2	4	4.8
Corn Gluten, Kg.	241	320	400	480
Calcium carbonate, Kg.	342.2	457.6	572	686.4

Table 2. Experimental ration for a small mixer using carrier maltodextrin and sucrose taken from adwia s.o.p

Composition	Batch size, kg			
	100	150	200	250
Nicotinamide F.G, Kg.	0.2	3	4	5
Aerosil 200, Kg.	2	0.15	0.2	0.25
Vitamin (K3) minadion, Kg.	0.1	0.6	0.8	1
Vitamin (B12) 1 %, Kg.	1	1.5	2	2.5
Folic acid, Kg.	0.025	0.037	0.05	0.062
Vitamin B6 (pyridoxine) HCL, Kg.	0.2	0.3	0.4	0.5
Vitamin B2 80 %, Kg.	0.5	0.75	1	1.25
Vitamin B1, Kg.	0.2	0.3	0.4	0.5
cal.pantothenate, Kg.	0.4	0.6	0.8	1
maltodextrin, Kg.	47.889	71.513	95.35	119.188
sucrose, Kg.	47.486	71.25	95	118.75

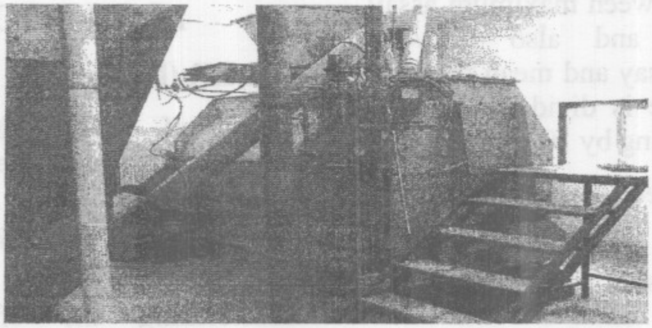

Fig. 1. BUHLER (big mixer)

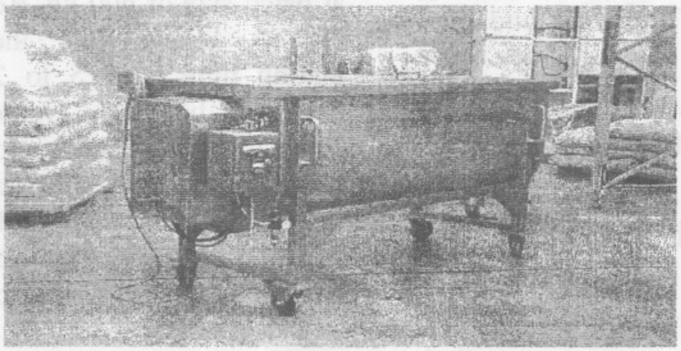

Fig. 2. RIBBON (small mixer)

Mean value ($\overline{X}$): The mean value of a population, as follows:

$$\bar{x} = \frac{\sum xi}{n} \ldots\ldots\ldots\ldots (1)$$

Where: $\sum xi$ = sum of samples.

n = number of samples assayed.

Coefficient of variation: (C.V.)

An expression for sample variability relative to the mean. It is defined as:

$$C.V\ \% = \frac{S}{\overline{X}} \times 100\ \% \quad \ldots. (2)$$

Where: s is the Standard deviation. The amount of variation in the sample population defined as:

$$S = \sqrt{\frac{\sum x^2 - \frac{\left(\sum xi\right)^2}{n}}{n-1}} \ldots (3)$$

Homogeneity

Sufficient samples were taken from the top, middle and bottom of the mixer Homogeneity is calculated by determining both maximum assay and minimum assay then calculating the deviation between maximum assay and mean and also between minimum assay and mean then the greater value is divided by mean and multiplying by 100.

Energy requirement

Energy requirements were obtained using the following equation:

Energy requirements (kW.h/Mg) = Power (kW)/ mixer productivity, Mg/h... (5)

Productivity was calculated from the following relation:

$$\text{Productivty (Mg/h)} = \frac{Wp}{T} \times 3.6 \quad ....(6)$$

Where: Wp = mixing mass (kg).

T= consumed time (second).

Mixing cost

The machine cost is estimated according to the conventional method (straight line) of estimating both fixed and variable costs. While mixing cost was calculated using the following formula:

Mixing cost (L.E. /Mg) = Machine operating cost (L.E/h) / productivity (Mg/h)........... (7)

RESULTS AND DISCUSSION

BUHLER (big mixer)

Effect of mixing time and batch size on the mixer performance using calcium carbonate and corn gluten as a carrier material

Concerning the effect of mixing time on mixer performance at batch size of 600 kg, Results in Fig. 3 Shows that increasing mixing time from 5 to 20 min. decreased both C.V. values from 21.85 to 7.70 % and homogeneity from 24.77 to 14.47% and also increased the mean from 18.82 to 20.88. Relating to the effect of mixing time on mixer performance at batch size of 800 kg, results show that increasing mixing time from 5 to 15 min. decreased both C.V. values from 12.04 to 4.48 % and homogeneity from 18.33 to 7.12% and also decrease the mean from 20.96 to 20.68.Any further increase in mixing time more than 15 up to 20 min, C.V. values will increase from 4.84 to 13.79% also homogeneity will increase from 7.12 to 19.06 And also the mean will decrease from 20.68 to20.06. With regard to the effect of mixing time on mixer performance at batch size of 1000 kg, results show that increasing mixing time from 5 to 15 min. decreased both C.V. values from 18.30 to 6.23 % and homogeneity from 27.90 to 8.45% and also decrease the mean from 20.70 to 20.17.Any further increase in mixing time more than15 up to 20 min, C.V. values will increase from 6.23 to 11.07% also homogeneity will increase from 8.45 to 11.75. And also the mean will decrease from 20.27 to 20.17.As to the effect of mixing time on mixer performance at batch size of 1200 kg, results show that increasing mixing time from 5 to 10 min. decreased both C.V. values from 9.75 to 5.21 % and homogeneity from 12.48 to 6.86% and also increased the mean from 19.75 to 20.25.any further increase in mixing time more than 10min up to 20 min, C.V. values will increase from 5.21 to 17.80% also homogeneity will increase from 6.86 to 16.60 and also the mean will decrease from 20.25 to 19.20.

Effect of mixing time and batch size on the mixer performance using calcium carbonate only as a carrier material

Concerning the effect of mixing time on mixer performance at batch size of 600 kg, Results Fig. 4 shows that increasing mixing time from 5 to 10 min. decreased both C.V. values from 11.19 to 3.24% and homogeneity from 18.82to 4.47% and also increased the mean from 20.46to 20.51.any further increase in mixing time more than10 up to 20 min, C.V. values will increase from 3.24 to 7.89% also homogeneity will increase from 4.47 to 11.69 And also the mean will decrease from 20.51 to 20.67.Relating to the effect of mixing time on mixer performance at batch size of 800 kg, results show that increasing mixing time from 5 to 15 min. decrease both C.V. values from 11.17 to 4.41 % and homogeneity from 19.08 to 4.83 % and also the increase the mean 19.80 to 20.21.any further increase in mixing time more than15 up to 20 min, C.V. values will increase from 4.41 to 14.06% also homogeneity will increase from 4.83 to 18.26And also the mean will decrease from 20.21 to 20.08. Relating to the effect of mixing time on mixer performance at batch size of 1000 kg, results show that increasing mixing time from 5 to 10 min. decreased both C.V. values from 11.57 to 4.11 % and homogeneity from 19.07 to 6.17% and also decreased the mean from 20.74 to 20.37.Any further increase in mixing time more than10 min up to 20 min, c.v. values will increase from 4.11 to 12.37% also homogeneity will

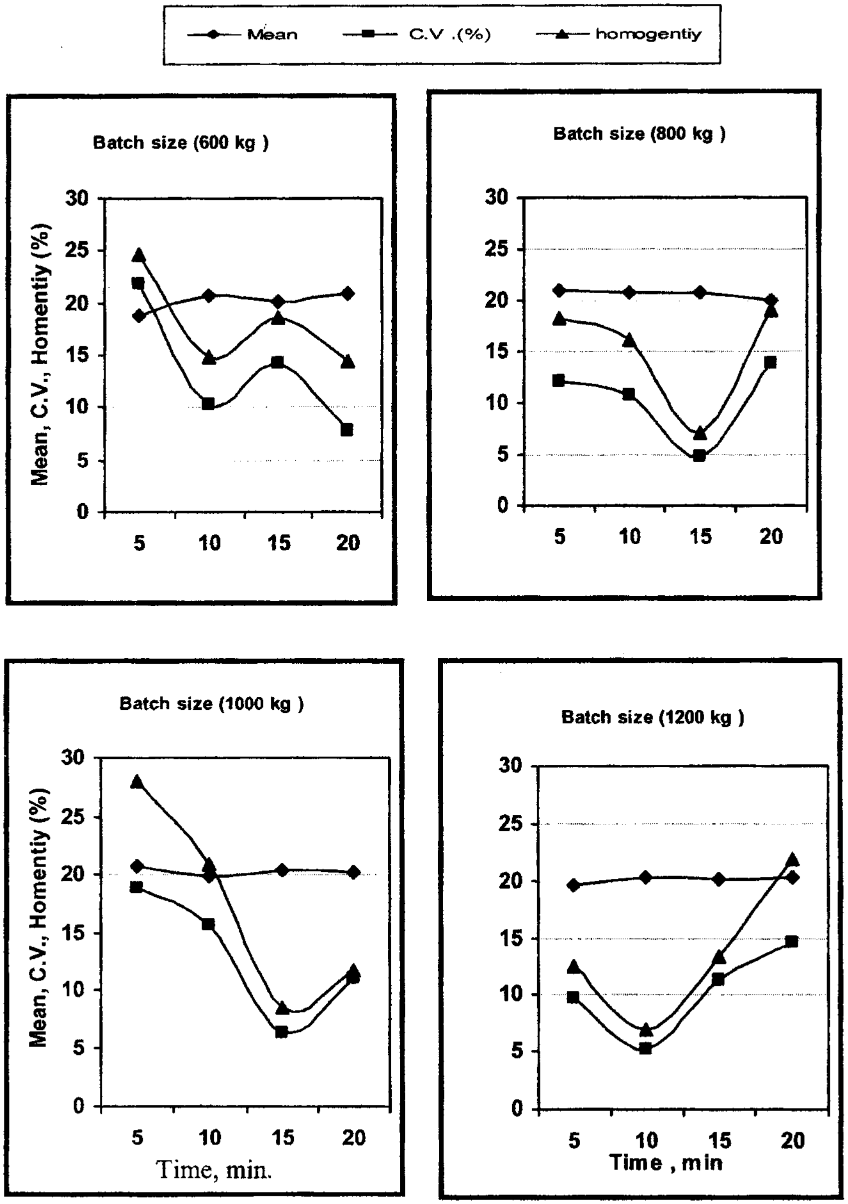

Fig. 3. Effect of mixing time and patch size on the mixer performance using calcium carbonate and corn gluten as a carrier material

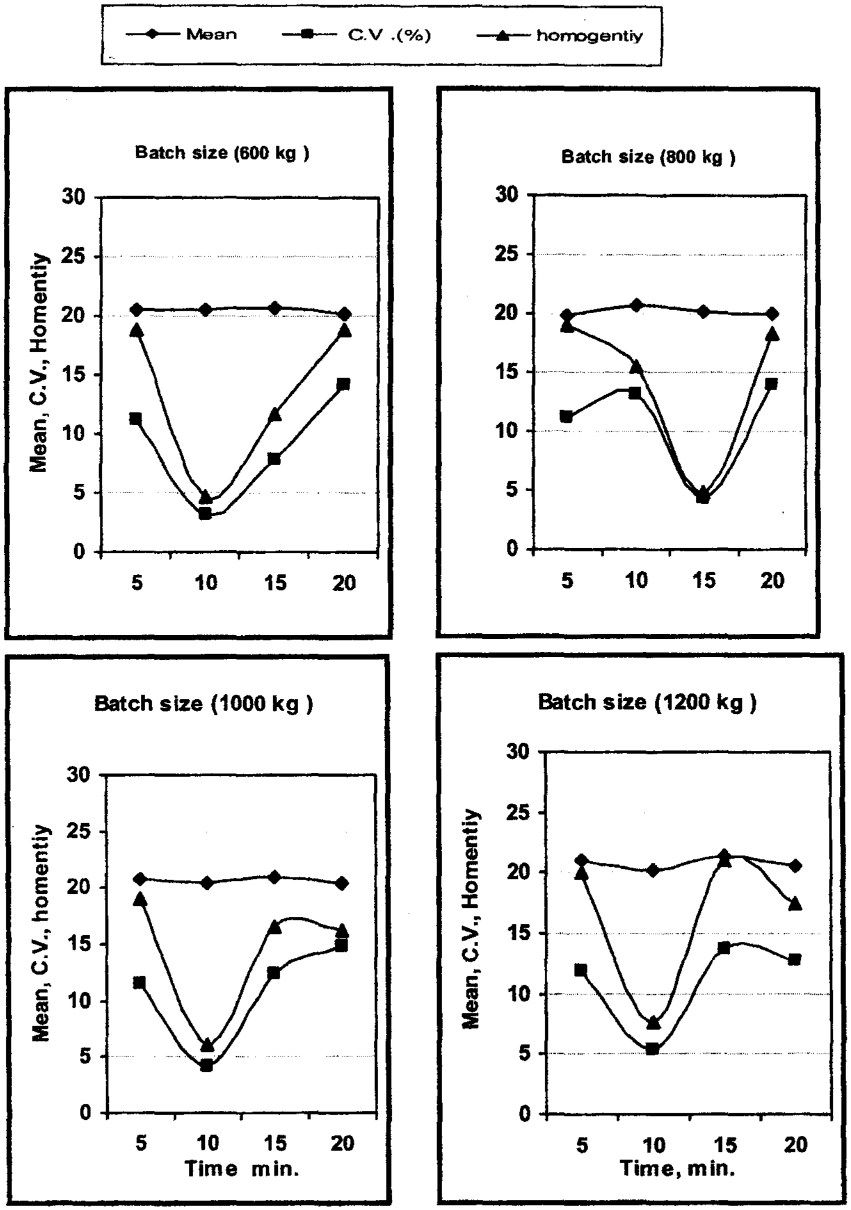

Fig. 4. Effect of mixing time and batch size on the mixer performance using calcium carbonate only as a carrier material

increase from 6.17 to 16.49 and also the mean will increase from 20.37 to 20.88.As to the effect of mixing time on mixer performance at batch size of 1200 kg, show that increasing mixing time from 5 to 10 min. decreased both c.v. values from 11.85 to 5.43 % and homogeneity from 20.06 to 7.70% and also decreased the mean from 21.00 to 20.16. Any further increase in mixing time more than 10 min up to 20 min, c.v. values will increase from 5.43 to 13.70% also homogeneity will increase from 7.70 to 20.97 and also the mean will increase from 20.16 to 21.28.

Effect of mixing time and batch size on the mixer performance using corn gluten only as a carrier material

Concerning the effect of mixing time on mixer performance at batch size of 600 kg, Results show in Fig. 5 show that increasing mixing time from 5 to 15 min. decreased both c.v. values from 10.31 to 7.35% and homogeneity from 16.22 to 10.66% and also decreased the mean from 20.35 to 19.92.Any further increase in mixing time more than15 up to 20 min, C.V. values will increase from 7.35 to 11.04% also homogeneity will increase from 10.66 to 19.41 And also the mean will increase from 19.92 to 20.33.Relating to the effect of mixing time on mixer performance at batch size of 800 kg, results show that increasing mixing time from 5 to 10 min decreased both C.V. values from 11.79 to 7.08 % and homogeneity from 18.86 to 10.95% and also the mean decreased from 20.07 to 19.99.

Any further increase in mixing time more than10 up to 20 min, C.V. values will increase from 7.08 to 12.38% also homogeneity will increase from 10.95 to 15.22 and also the mean will increased from 19.99 to 20.09. Regarding to the effect of mixing time on mixer performance at batch size of 1000 kg, results show that increasing mixing time from 5 to 15 min. decreased both C.V. values from 21.51 to 6.26 % and homogeneity from 16.42 to 9.05% and also decrease the mean from 20.30 to 20.18.any further increase in mixing time more than 20 min up to 20 min, c.v. values will increase from 6.26 to 9.88% also homogeneity will increase from 9.05 to 12.82 and also the mean will decreased from 20.18 to 19.78. As to the effect of mixing

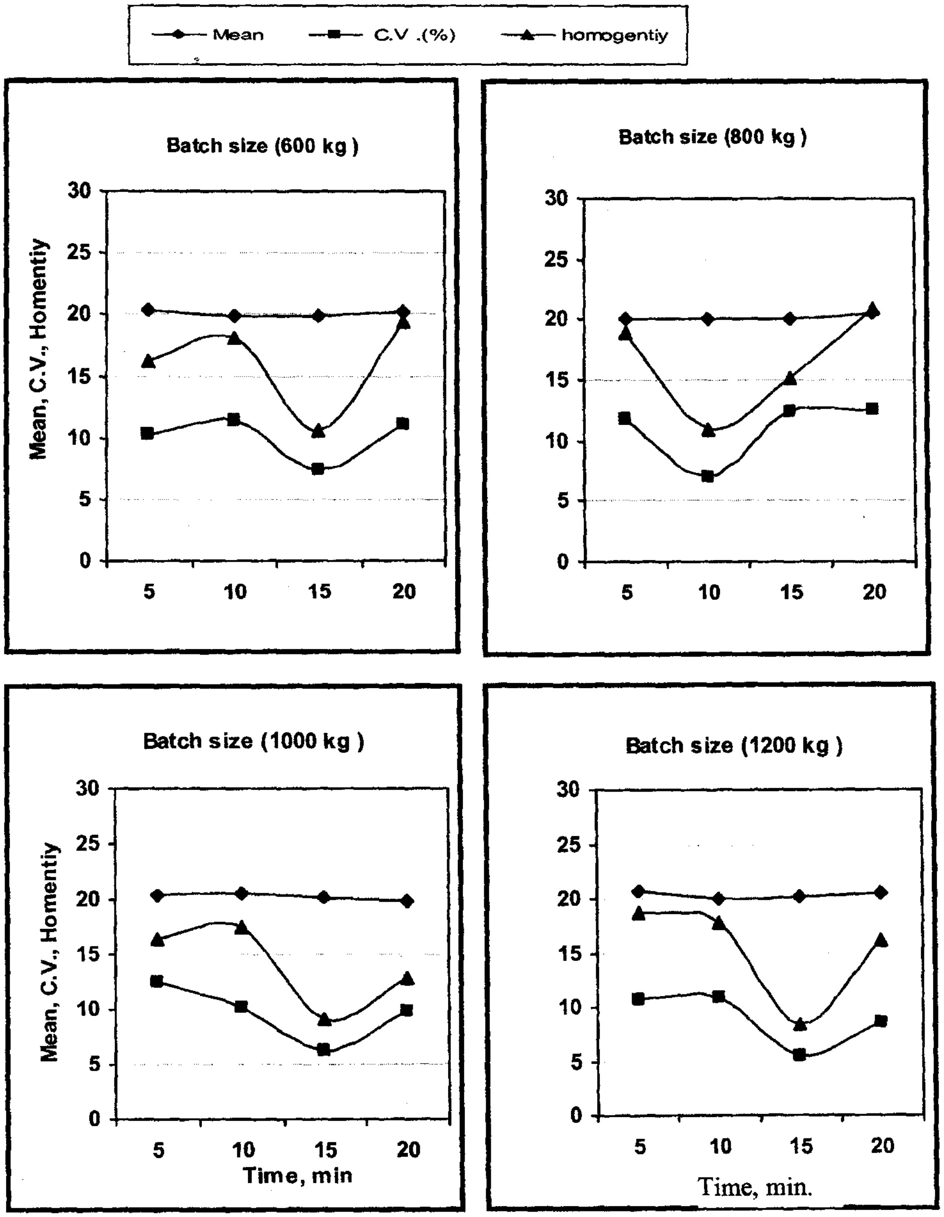

Fig. 5. Effect of mixing time and batch size on the mixer performance using corn gluten only as a carrier material

time on mixer performance at batch size of 1200 kg, results Show that increasing mixing time from 5 to 15 min. decreased both C.V. values from 10.76 to 5.46 % and homogeneity from 18.81 to 8.38 % and also decreased the mean from 20.80 to 20.26.any further increase in mixing time more than15 up to 20 min, c.v. values will increase from 5.46 to 8.46% also homogeneity will increase from 8.38 to 16.22 and also the mean will increase from 20.26 to 20.63.

Effect of mixing time and batch size on energy requirements for BUHLER mixer

Fig. 6 shows the effect of both mixing time and batch size on the energy requirements. Considering the effect of mixing time on the energy requirements results show that increasing mixing time from 5 to 20 minutes increased energy requirements from 4.17 to 16.67, from 3.13 to 12.50, from 2.50 to 10.00, and from 2.08 to 8.33 KW.h/ton at batch sizes of 600, 800, 1000 and 1200 kg, respectively. Relating to the effect of batch size on energy requirements, obtained data show increasing batch size from 600 to 1200 kg decreased energy requirements from 5 to 2.08, from 10 to 4.7, from 15 to 6.2, and from 20.to 8.3 kW.h/ton at mixing time of 5, 10,15and 20 minutes, respectively.

Effect of mixing time and batch size on mixing cost for BUHLER mixer

Fig. 7 shows the effect of both mixing time and batch size on mixing cost considering the effect of mixing time on mixing cost results show that increasing mixing time from 5 to 20 minutes increased cost from 56 to 222, from 42 to 167, from 33 to 133, and from 28 to 111 L.E./ton at batch sizes of 600, 800, 1000 and 1200 kg, respectively. Relating to the effect of batch size on mixing cost, obtained data show increasing batch size from 600 to 1200 kg decreased energy requirements from 66 to 28, from 111 to 56, from 167 to 83, and from 222 to 111 L.E/ton at mixing time of 5,10,15and 20 minutes, respectively.

RIBBON (small mixer)

Effect of mixing Time and batch size on the mixer performance using Maltodextrin and sucrose as a carrier material

Concerning the effect of mixing time on mixer performance during mixing of vitamin B_1at batch size of 100 kg, Results Fig. 8 shows

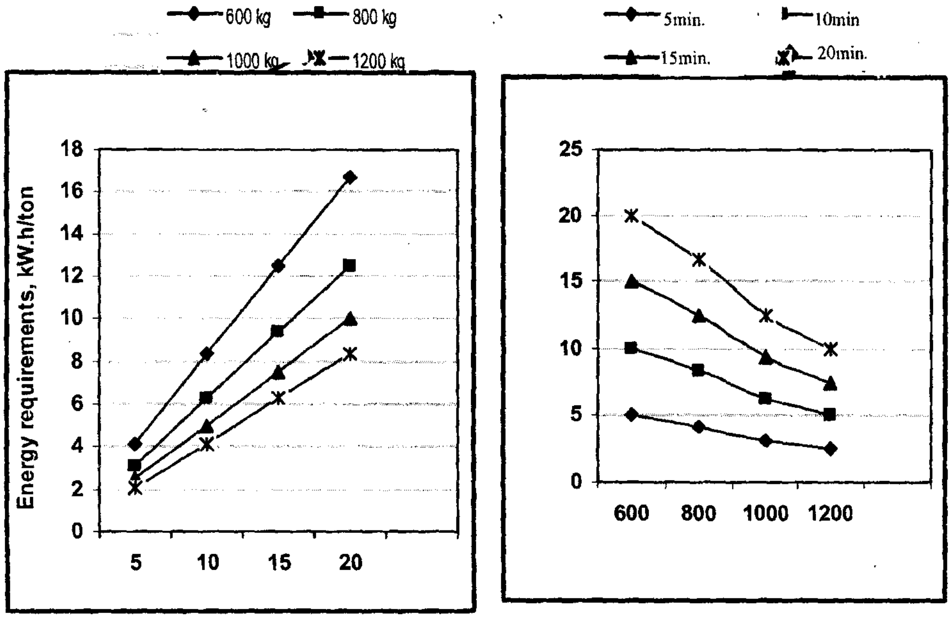

Fig. 6. Effect of mixing time and batch size on energy requirements at using corn gluten and calcium carbonate as a carrier material

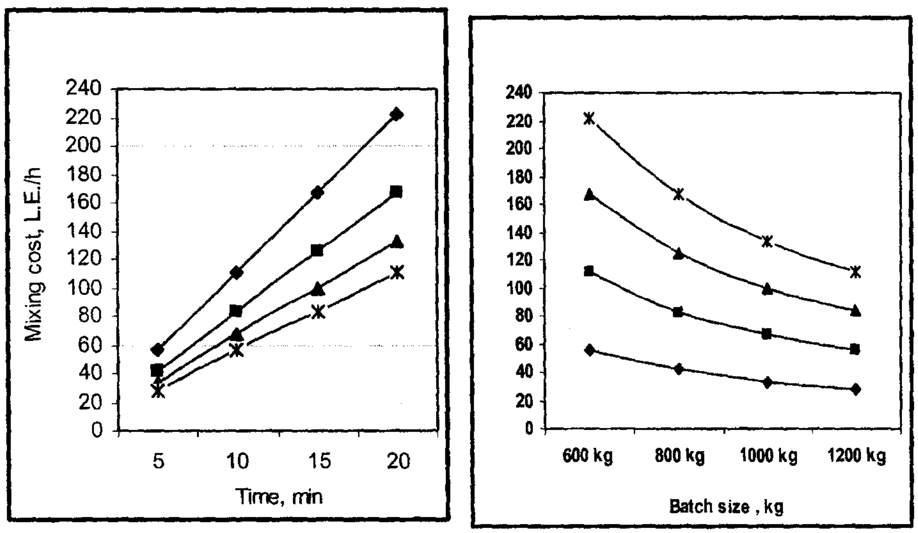

Fig. 7. Effect of mixing time and batch size on mixing cost using corn gluten and calcium carbonate as a carrier material

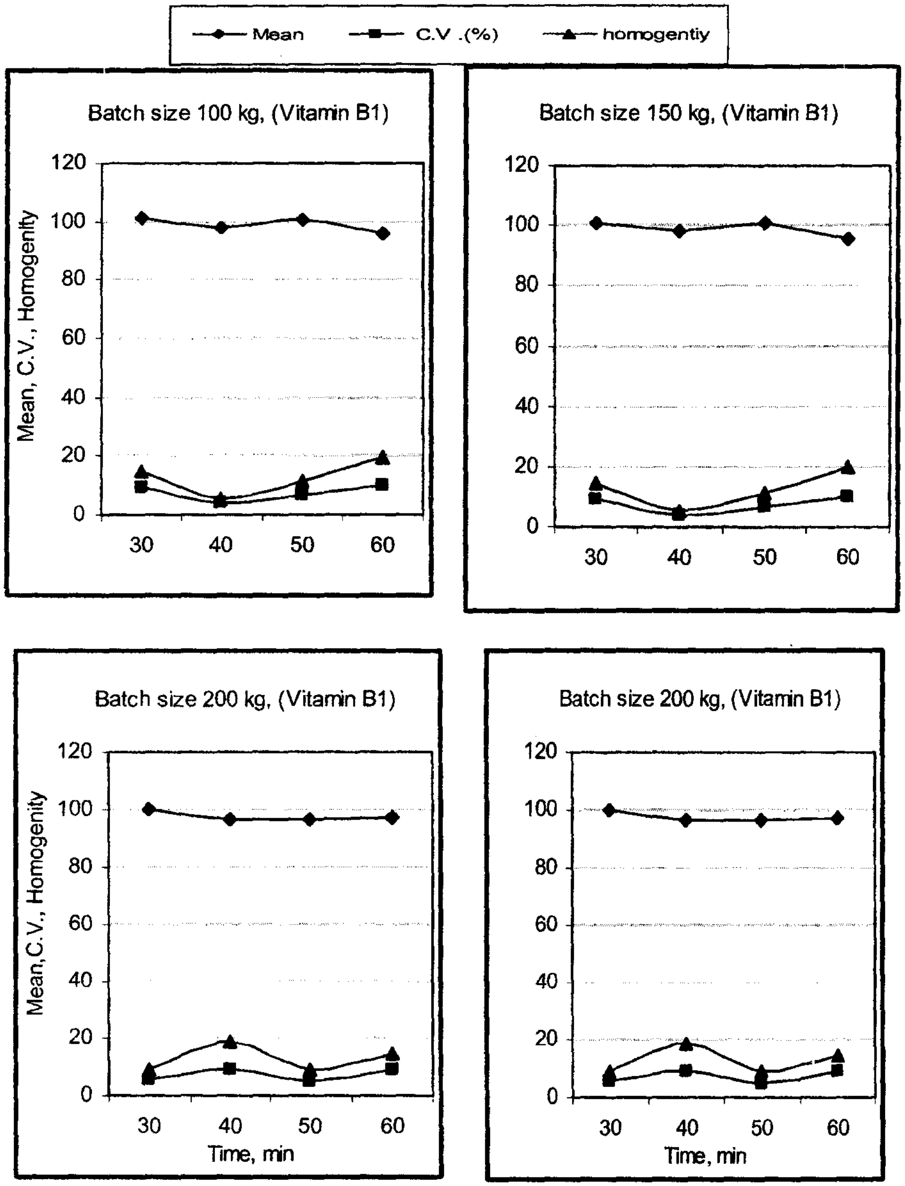

Fig. 8. Effect of mixing time and batch size on the mixer performance using sucrose and Maltodextrin as a carrier material

that increasing mixing time from 30 to 40 min. decreased both C.V. values from 9.10 to 3.74% and homogeneity from 14.68 to 5.58 % and also decreased the mean from 100.89 to 97.8. Any further increase in mixing time more than 40 up to 50 min, C.V. values will increase from 3.74 to 6.57 % also homogeneity will decreased from 5.58 to 11.39 And also the mean will increase from 97.80 to 100.60.Concerning the effect of mixing time on mixer performance during mixing of vitamin B_1at batch size of 150 kg, Results show that increasing mixing time from 30 to 40 min. decreased both C.V. values from 10.02 to 3.31 % and homogeneity from 11.34 to 4.63 % and also increased the mean from 98.69 to 97.62.Any further increase in mixing time more than 40 up to 60 min, C.V. values will increase from 3.31 to 8.53 % also homogeneity will increase from 4.63 to 9.03 and also the mean will decrease from 98.69 to 97.17. Concerning the effect of mixing time on mixer performance during mixing of vitamin B1 at batch size of 200 kg. Results show that increasing mixing time from 30 to 50 min. decreased both C.V. values from 5.52 to 4.92 % and homogeneity from 8.69 to 8.75 % and also decreased the mean from 99.92 to 96.73. Any further increase in mixing time more than40 up to 60 min, c.v. values will increase from 4.92 to 9.10 % also homogeneity will increase from 8.75 to 14.71 And also the mean will increase from 96.73 to 97.24. Concerning the effect of mixing time on mixer performance during mixing of vitamin B1at batch size of 250 kg, Results show that increasing mixing time from 30 to 60 min. decreased both C.V. values from 9.14 to 3.66 % and homogeneity from 17.16 to 5.42 % and also decrease the mean from 97.48 to 97.41.

Effect of mixing Time and batch size on the mixer performance using Maltodextrin only as a carrier material

Concerning the effect of mixing time on mixer performance during mixing vitamin B_1 at batch size of 100 kg, Results in Fig. 9 shows that increasing mixing time from 30 to 40 min. decreased both C.V. values from 10.92 to 2.90 % and homogeneity from 8.54 to 4.12 % and also increased the mean from 96.71 to 97.47. Any further increase in mixing time more than 40 up to 60 min, C.V. values will increase from 2.90 to 10.81 %

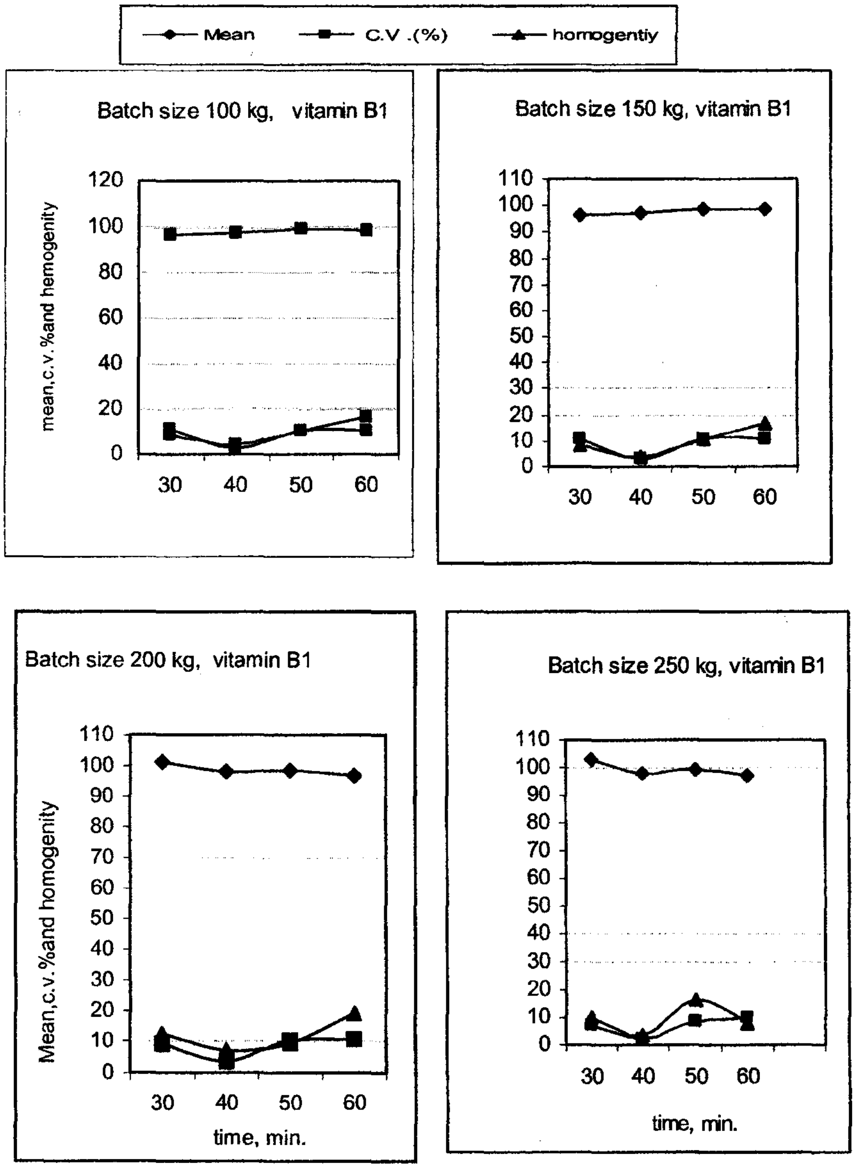

Fig. 9. Effect of mixing time and batch size on the mixer performance using Maltodextrin only as a carrier material

also homogeneity will increase from 4.12 to 10.79 and also the mean will increase from 97.47 to 98.88. Concerning the effect of mixing time on mixer performance during mixing of vitamin B1 at batch size of 150 kg, results show that increasing mixing time from 30 to 40 min. decreased both C.V. values from 8.68 to 2.41 % and homogeneity from 8.70 to 3.46 % and also increased the mean from 96.54 to 97.63.Any further increase in mixing time more than 40 up to 60min, C.V. values will increase from 2.41 to 8.72 % also homogeneity will increase from 3.46 to 9.04 and also the mean will decrease from 97.63 to 97.25. Concerning the effect of mixing time on mixer performance during mixing of vitamin B_1at batch size of 200 kg, results show that increasing mixing time from 30 to 40 min. decreased both C.V. values from 9.02 to 3.64 % and homogeneity from 12.37 to 6.88 % and also decreased the mean from 101.22 to 97.98. any further increase in mixing time more than 40 up to 60 min, C.V. values will increase from 3.64 to 10.22 % also homogeneity will increase from 6.88 to 9.37 and also the mean will decrease from 97.98 to 98.4. Concerning the effect of mixing time on mixer performance during mixing of vitamin B_1 at batch size of 250 kg, results show that increasing mixing time from 30 to 40 min decreased both C.V. values from 7.25 to 2.31 % and homogeneity from 10.13 to 3.66 % and also decreased the mean from 102.77 to 97.68.Any further increase in mixing time more than 40 up to 60min, C.V. values will increase from 2.31 to 8.53 % also homogeneity will increase from 3.66 to 16.54And also the mean will increase from 97.68 to 99.04.

Effect of mixing time and batch size on the mixer performance using sucrose only as a carrier material

Concerning the effect of mixing time on mixer performance during mixing of vitamin B_1 at batch size of 100 kg, results Fig. 10 shows that increasing mixing time from 30 to 50 min. decreased both C.V. values from 10.14 to 3.00 % and homogeneity from 10.30 to 5.86 % and also increased the mean from 98.22 to 97.83.any further increase in mixing time more than 40 up to 60 min, C.V. values will increase from 3.00 to 10.99 % also homogeneity will increase from

5.86 to 18.46And also the mean will decrease from 97.83 to 97.25.

Concerning the effect of mixing time on mixer performance during mixing of vitamin B_1 at batch size of 150 kg, results show that increasing mixing time from 30 to 40 min decreased both C.V. values from 10.82 to 2.51 % and homogeneity from 12.30 to 4.51 % and also decreased the mean from 101.23 to 99.82. Any further increase in mixing time more than 40 up to 60 min, C.V. values will increase from 2.51 to 10.01 % also homogeneity will increase from 4.51 to 12.44 and also the mean will increase from 99.82 to 101.02. Concerning the effect of mixing time on mixer performance during mixing of vitamin B1 at batch size of 200 kg, results show that increasing mixing time from 30 to 40 min. decreased both C.V. values from 10.84 to 4.59 % and homogeneity from 11.42 to 5.63 % and also increased the mean from 98.12 to 98.27. Concerning the effect of mixing time on mixer performance during mixing of vitamin B_1 at batch size of 250 kg, results show that increasing mixing time from 30 to 60 min. decreased both C.V. values from 9.22 to 4.08 % and homogeneity from 13.23 to 5.80% and also decreased the mean from 102.33 to 98.04.

Effect of mixing time and batch size on energy requirements for RIBBON

Fig. 11 shows the effect of both mixing time and batch size on the energy requirements. Considering the effect of mixing time on the energy requirements results show that increasing mixing time from 30 to 60 minutes increased energy requirements from 22 to 110, from 37 to73, from 28 to 55,and from 22 to 44 kW.h/ton at batch sizes of 100, 150, 200 and 250 kg, respectively. Relating to the effect of batch size on energy requirements, the obtained data show increasing batch size from 100 to 250 kg decreased energy requirements from 55to 22, from 73to 29, from 92 to 37, and from 110 to 44 kW.h/ton at mixing time of 30, 40, 50 and 60 minutes, respectively.

Effect of mixing time and batch size on mixing cost for RIBBON mixer

Fig. 12 shows the effect of both mixing time and batch size on mixing cost. Considering the effect of mixing time on mixing cost results show that increasing mixing time from 30 to 60 minutes increased cost from 250 to 500, from 167 to 333, from 125 to 250 and

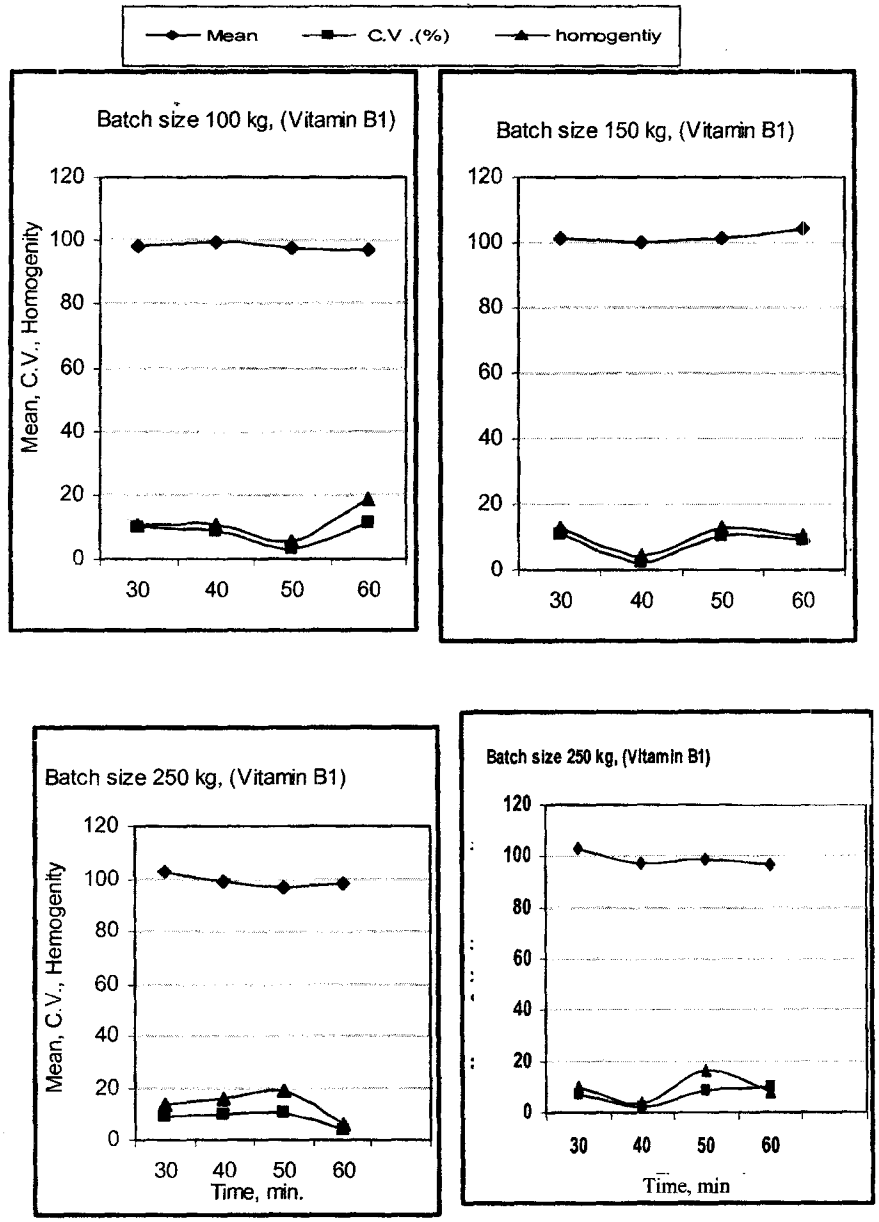

Fig. 10. Effect of mixing time and batch size on the mixer performance using sucrose only as a carrier material

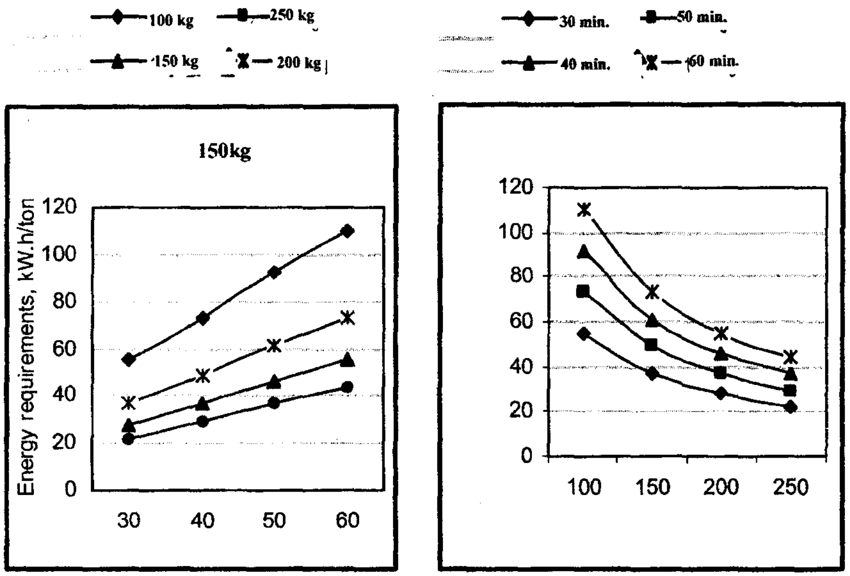

Fig. 11. Effect of mixing time and batch size on energy requirements for RIBBON

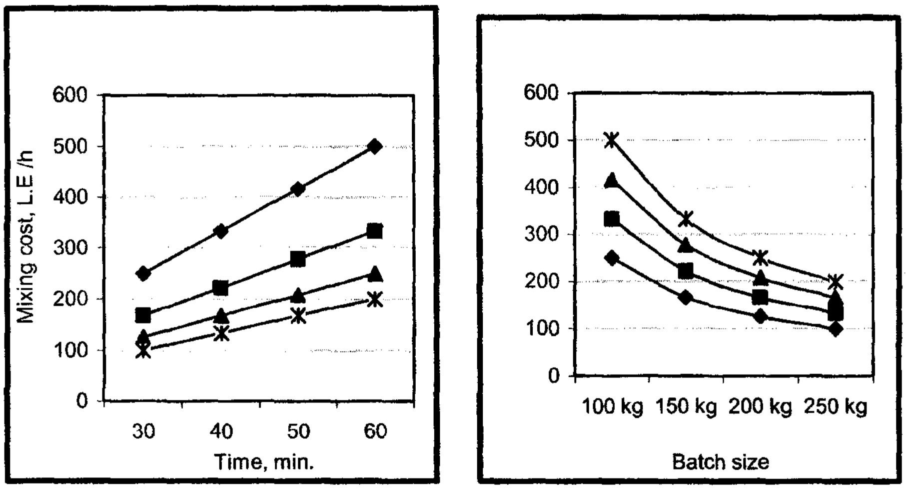

Fig. 12. Effect of mixing time and batch size on mixing cost using sucrose and Maltodextrin as carrier material

from 100 to 200 L.E./ton at batch sizes of 100, 150, 200 and 250 kg, respectively. Relating to the effect of batch size on mixing cost, the obtained data show that increasing batch size from 100 to 250 kg decreased energy equirements from 250 to 100, from 333 to 133, from 417 to 167 and from 500 to 200 L.E./ton at mixing time of 30, 40, 50 and 60 minutes, respectively.

Conclusion

1. The BUHLER (big mixer) is recommended to be used for producing feed additives for batch size between 1000 and 1200 kg because of its minimum energy requirements and production costs at mixing time of 10 min using carrier material calcium carbonate and corn gluten with ratio of 1:3.
2. The RIBBON (small mixer) is recommended to be used for producing feed additives and concentrated for batch size between 200 and 250 kg because of its minimum energy requirements and production costs at mixing time of 60 min using carrier material sucrose and Maltodextrin with ratio of 1:1.

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دراسة مقارنة بين بعض أنظمة خلط وتصنيع إضافات الأعلاف و المركزات

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أجريت هذه الدراسة بمصنع لإنتاج إضافات الأعلاف والمركزات بمدينة العبور- محافظة القليوبية - جمهورية مصر العربية لدراسة العوامل المؤثرة على إنتاج وتصنيع الأعلاف والمركزات التي تعمل بنظام الخلط والتقليب وتحديد أفضل الطرق للوصول إلى أعلى جودة للمنتج تحت عوامل التشغيل المختلفة.

وكانت أهداف الدراسة هي:

١- تقييم أداء نوعين من أشهر أنظمة خلط وتصنيع إضافات الأعلاف والمركزات في مصر بغرض إنتاج إضافات علف ومركزات ذو جودة عالية لتحقيق الهدف المنشود منها في تحسين إنتاج الثروة الحيوانية.

٢- تحديد أفضل عوامل التشغيل المستخدمة للحصول على أعلى كفاءة تشغيل لأنظمة الخلط والتقليب المستخدمة.

٣- حساب الطاقة المطلوبة لتشغيل نوعين من أنظمة الخلط.

٤- تقييم أداء بعض من أنظمة خلط وتصنيع إضافات الأعلاف والمركزات اقتصادياً.

وقد تم إجراء مجموعتان من التجارب وهي كالتالي:

- المجموعة الأولى: أجريت هذه المجموعة من التجارب باستخدام الخلاط الكبير (BUHLER) تحت أربع أزمنة للخلط وهي (٥ ، ١٠ ، ١٥ و ٢٠ دقيقة) وتحت أربعة تشغيلات مختلفة الحجم هي (٦٠٠ ، ٨٠٠ ، ١٠٠٠ و ١٢٠٠ كج) وثلاث أنواع من المادة الحاملة هي (قشر حبوب الذرة الناعم وكربونات الكالسيوم، كربونات الكالسيوم فقط وقشر حبوب الذرة الناعم فقط).

- المجموعة الثانية: أجريت المجموعة الثانية من التجارب باستخدام الخلاط الصغير (RIBBON) تحت أربع أزمنة للخلط وهى (٣٠ ، ٤٠ ، ٥٠ و٦٠ دقيقة) وتحت أربعة تشغيلات مختلفة الحجم هي (١٠٠ ، ١٥٠ ، ٢٠٠ و ٢٥٠ كج) وثلاث أنواع من المادة الحاملة هي (مالتي دكسترين وسكر، مالتي دكسترين فقط وسكر فقط).

تم تقييم المعاملات السابقة أخذاً في الاعتبار كل من إنتاجية خط إنتاج الأعلاف والمركزات، الطاقة اللازمة لعملية الخلط و التكاليف الكلية لعملية الخلط.

وقد أوضحت النتائج المتحصل عليها ما يلي:

١- استخدام خلاط (BUHLER) في إنتاج إضافات الأعلاف عندما يكون حجم التشغيلة من ١٠٠٠ إلى ١٢٠٠ كجم وزمن الخلط المناسب ١٠ دقائق واستخدام مادة حاملة هي خليط من قشر الذرة وكربونات الكالسيوم بنسبة ٣:١ حيث يؤدي ذلك الي تقليل الطاقة المستهلكة وكذلك التكاليف الكلية لعملية الخلط.

٢- استخدام خلاط (RIBBON) في إنتاج إضافات الأعلاف عندما يكون حجم التشغيلة من ٢٠٠ إلى ٢٥٠ كجم وزمن الخلط المناسب ٦٠ دقيقة واستخدام مادة حاملة هي خليط من مالتي دكسترين وسكروز بنسبة ١:١ حيث يؤدي ذلك الي تقليل الطاقة المستهلكة وكذلك التكاليف الكلية لعملية الخلط.