

EVALUATION AND COMPARING THE LOSSES OF DIFFERENT JUICE PACKAGING RATES AND SYSTEMS IN THREE JUICE PLANTS

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ABSTRACT

This research was conducted to evaluate and compare the juice damaged packages, bottles and quantities of juice losses under different rates of packaging processes. Six rates were studied in plant A and five rates in plant B and C for two different products of juices using tetra brick aseptic packaging machine (TP), vole pack packaging machine (VP) and Automatic vacuum filer/capper machine (AUV) in addition to quantities of juice losses. The damage juice packages, bottles and the quantity of juices losses accompanied with each rates in the plants were compared and the results cleared that the suitable machine rateses for different packaging system in plants.(A), (B) and (C).

Experiments cleared that the suitable machine rates were 6300 and 5460 pack/hr for TP. mango juice 200 ml and 1000 ml in plant A respectively,while they were 5460 and 5520 pack/hr for VP.240 mango and apple juice 130 gm, 4860 and 4800 pack/hr for VP.240 mango and apple juice 200 gm, they were 3540 and 3420 bottle/hr for AUV mango and apple juice 200 ml in plant B respectively, in addation to 3240 and 3540 pack/hr for VP. apple juice 130 ml and 200 ml in plant C respectively.

Key words: *juice, plant, losses, saving, Tetra brick aspetic, Volpack, automatic vacuum filer/capper packiging machine.*

INTRODUCTION

Packing operatesion is most important in juice processing. The losses of product and packaging represent an essential problem during packaging process Jean (2016) Saied that In the U.S. dairy industry, milk losses can average 2 to 3% from the time the raw milk enters the factory until the finished product is packaged and shipped.

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One solution is employing equipment designed to maximizing efficiency and minimizing product losses.

Egyptian E.A.A.I.M. (2015) found that the estimated losses rate was 2% for aseptic packaging machines which used in packaging sterilized milk. The sterilized milk packaged in Tetra Brick Aseptic portion packages validity period 6 months Compared to pasteurized milk filled in bottles of polyethylene validity period was a week only.

Hanafy (2010) studied that the packaging losses for two different products named fluid milk and vita cheese using tetra brick aseptic packaging machine at different rates of packaging processes in dairy plant. The result of the study revealed that the suitable machine rate for packaging milk volum 200 ml, 500 ml and 1000 ml were (7140, 5160, & 6420) pack/h while the Vita cheese weight (250 and 500) gm were (5160 & 5040) pack/h in plant respectively.

OVAM (2015) reported that soft drinks losses during the syrup preparation and the filling process negligible percentage of loss (<1%).

Dairy-technology (2014) mentioned that in the packing operation, losses are mostly due to over filling, spillage and failure of packing. In milk packing, the loss of 0.5 to 1.0% is general. The general reason for losses during packing is negligence, carelessness and safety margin due to stringent laws and machine sensitivity.

Wikipedia (2014) reported that aseptic packages are typically a mix of paper (70%), polyethylene (LDPE) (24%), and aluminum (6%), with a tight polyethylene inside layer.

Organization (2012), reported that the most important consumer packaging are made of paper and board (38%), followed by plastic (30%) with rigid plastics alone taking an 18% share, metal (19%), glass (8%), and others (5%).

UK Drinks sector (2010) reported that loss of product by overfilling occurs even with the most accurate filling equipment for one soft drinks company visited, visual fill losses accounted 1.3% yield loss. Improving filling efficiency dependent on the type of technology, age of the equipment and maintenance regimes in place.

Wkieducator.org (2008) reported that packaging containers designed to protection materials from outside influences. Packaging materials were Paper which accounts for about 50% of all packaging. Glass is also has excellent barrier properties, transparent, reusable, reasonably strong, easy to open. Aluminum foil and polyethylene used for fruit juice, and soft drinks packaging while Tetra pack used for dairy products.

UNIDO (2004) reported that Typical losses during Packaging of fruits and vegetables with a percentage of loss 5-10.

Timothy and Jibing (1996) reported that factory lost glasses bottle of the finished product, normally 1.5 % occurred during the production stages the finished product, losses occurred during production of glasses bottle is acceptable, but the factory's losses has reached 4-10 percent.

According to that. This study aimed to evaluate and compare the volumes of damaged packages, quantity of product and electrical power losses during in packaging processes for two product including TP (mango juice 200 and 1000 ml) by using six different rates in plant (A) while two different product including VP 240 a (mango and apple juice) by using five different rates packaging system such as (mango juice 130, 200 gm and apple juice 130, 200 gm) and two product including AUV (mango juice 200 and apple juice 200 ml) by using five packaging rates also in plant (B) in addition to one product including VP (apple juice 130 and 200 ml) by using five packaging rates in plant (C). On this study Quantity losses juice and electrical power in plant (A), (B) and (C) applied to compute damaged packages and bottles (bad welding, damaged bottles or not complete filled) and losses product in lines or uncomplete packages during packaging process will appear by change packaging machine rates to determine the ratio of packages damaged, product and electrical power losses in this speed to choose the proper packaging machine rates to reduce the losses.

MATERIALS AND METHODS

The experiments were carried out in three plants were "Green Land" Middle East Co. (A), "Tiba" Co. (B) and "Biela" Co. (C) plants for food production at 10th of Ramadan City in the period from Jan., 2016 to Feb., 2016.

The specifications of different packing systems are:-

Plant A:

Tetra brick aseptic packaging machine:-Fig (1)

The machine packaged liquid juice in tetra brick aseptic portion packages with filler capacity ranged from 7500 to 6000 (-0%+4%) per hour and volumes available all existing TBA/19 volumes. It has an automatic splicing unit with double reel for packaging material. In this study the experiments were carried out on TP mango juice for volumes 200 ml and 1 liter. The Juice pasteurized by (HTST) system, using hot water at temperature of 85 °C with holding time 30 seconds then The pasteurized juice sterilized by (UHT) system by steam at temperature 95 °C with holding time 4 seconds. , after that, the product is cooled to 25 °C and pumped to packaging storage tank.

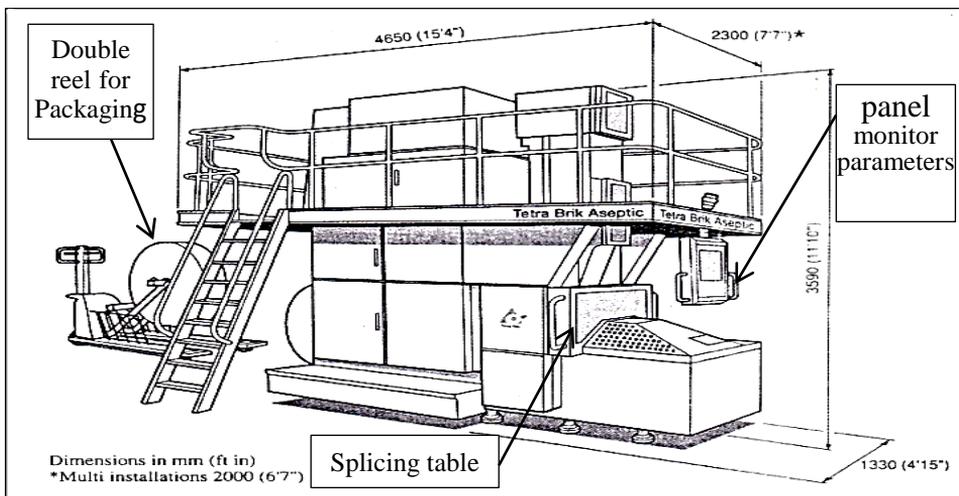


Fig. (1): Tetra brick aseptic packaging machine (Type: TBA/19-010V)

Packaging depart and losses:

Sterilized juice led to Tetra Brick Aseptic packaging machine to be packaged in Tetra Brick Aseptic portion packages. Packages are transported by conveyor to tubex straw applicator which provide the packages with tubex and transport by conveyor to tetra card board packer which collect packages in small groups in wrap around box, the box transported by conveyor to shrink machine to be wrapped the boxes with plastic cover, finally the product led to storage .

Plant B:**Vole pack machine (Type: 240):-Fig (2)**

The Vole pack machine is packed liquid food in vole packages and with filler capacity ranged from 4000 to 8000 (-0%+5%) per hour and volumes available were 130 gm and 200 gm. It was made of stainless steel and hardened glass frame. Its components are a one reel, automatic splicing unit for packaging material, buffer tank with level control, 4 axial welding knives, 4 filling valves, stainless steel conveyor, pump and panel unit. In this study the experiments were carried out on VP mango and apple juice for volumes 130 and 200 gm. Juice pasteurization by (HTST) system using hot steam at temperature 95 °C with holding time for 5 seconds after that The The pasteurized Juice failed in vole packages is cooled to 32 °C.

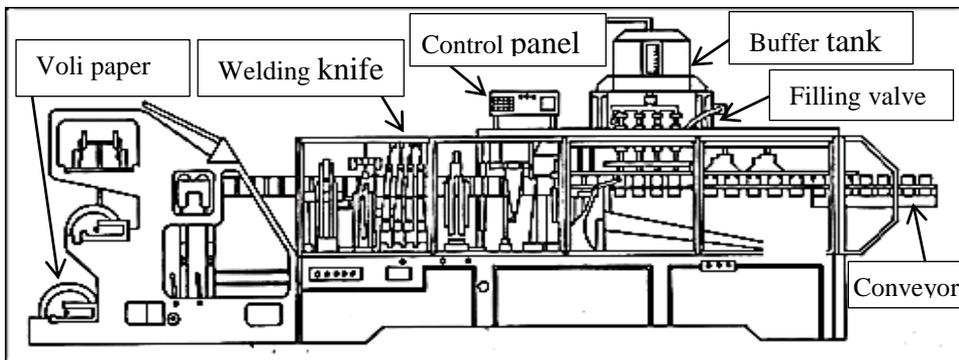


Fig. (2): Vole pack machine

Packaging depart and losses:

The hot juice pumped to volpack machine, it is coming from the uniflex heater to the buffer tank, the voli paper enter the machine and welded by axial and horizontal knife to form the voli packages, packages filled by two valves and completed by other two valve then the packages closed from the top by welding knife and get out from machine by stainless steel conveyor to the tunnel of cooling in package. The packages enter to the tunnel on a flat belt conveyor and sprayed by cooling water by the way of nozzles and it get out from the tunnel at temperature 32 °C then packaged in carton boxes manually . Finally the product led to storage.

Automatic vacuum filler/capper: - Fig (3)

The machine packages liquid food in in round glass bottles volume 200 ml with capacity from 1000 to 8000 bottle/hour, (-2%+5%) per hour and volumes available were 200 ml Its frame was made from stainless steel and hardened glass fixed on it. The machine components, are unscramble turn table, stainless steel filler conveyor, washing glass applicator with mechanical arm, six filling nozzles, vacuum pump, three capper star wheels, buffer tank with level control, temperature control unit, capper unit, capper conveyor, panel unit and crown unit. In this study the experiments were carried out on AUV mango and apple juice for volumes 200 ml Juice pasteurization by (HTST) system using hot water at temperature of 90 °C with holding time 25 seconds in (PHE) device then by (LTLT) system for 30 minutes at temperature 82.5 °C at first stage then 60 °C in the second stage after that the bottles sprayed by cooling water in third stage and the glasses get out from tunnel at temperatures 35 °C.

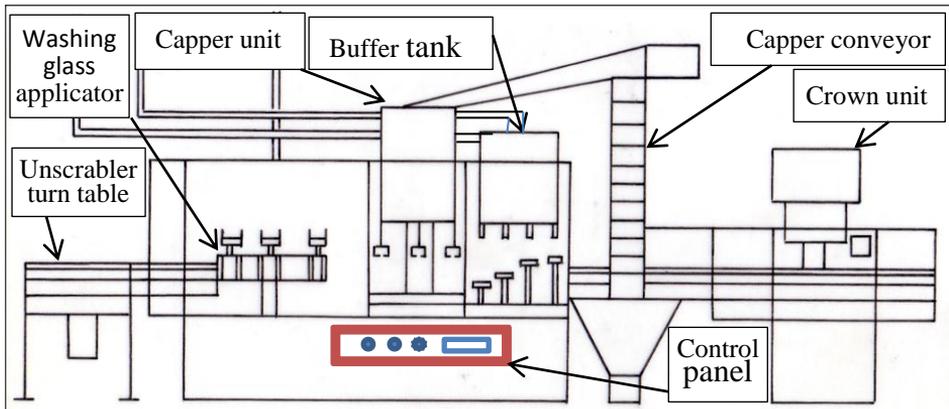


Fig. (3): Automatic vacuum filler/capper machine

Packaging depart and losses:

The juice is heated in (PHE) device to the pasteurization temperature 90 °C from 15 °C then the hot juice pumped to automatic vacuum filler/capper machine. Glass bottle put on unscrambler turn table and bottles will enter to filling by stainless steel conveyor, the bottle neck held by two index arms. They are washed by hot water, conveyor will stop and valves move down on the top of bottles neck, then the juice will

start flow to the bottles, after filling cycle complete the outer index will open and conveyor start to transport filled bottles to capping through capping star wheel one by one then the capping head move down on the top of bottle to close pilfer proof cap around the bottle neck, capping head designed to work on 28mm aluminum caps, the juice fill at 85 °C in round glass bottles volume 200 ml the filled bottles transported by flat belt conveyor to a tunnel of keep heating and cooling device. The glasses get out from tunnel at temperature 35 °C transported by conveyor and dried from water by air drier then the bottle enter labeling machine, glass bottles enter on the table of machine and with elastic conveyor to put the sticker on it, transported by conveyor to shrink machine where the bottles packaged manually in boxes on the table of machine, the boxes enter to the shrink machine to be wrapped by plastic cover, finally the product led to storage.

Plant C:-

Vole pack machine: - Fig (2)

The machine packages liquid food in vole packages and with filler capacity ranged from 3000 to 4000 (-0%+5%) per hour and volumes available were 130 ml and 200 ml. In this study the experiments were carried out on VP apple juice. Juice pasteurization by (LTLT) system for 40 minutes at temperature 90 °C using hot steam at temperature of 120 °C after that the pasteurized Juice failed in vole packages is cooled to 32 °C.

Packaging depart and losses:-

Juice preparing by crushing the pulp and putting it with sugar to cooker and preparing tanks, then water is added in tanks with a double jacket to quick dissolution with continuous mechanical mixing and heating by hot steam directly at temperature 120°C, the preparing juice take about 40 minutes and the solution temperature is raises to 90 °C. There are two cooker and preparing tanks for each volpack machine. The hot liquid juice pumped to the volpack machine then packages filled and get out from machine by stainless steel conveyor to the tunnel of cooling in package. The packages get out from the tunnel at temperature of 32 °C then packaged in carton boxes manually.

Instrumentations devices.**Temperature instruments:**

Digital multi-meter 1000 Model MY60 series hand held DMM Instruments with a thermocouple was used for monitoring temperature with an accuracy of (+1.0%) and at ranged from -20 °C to 1000 °C by reading liquid crystal display (LCD).

Packages losses and machine rates:

packages rates counter in the packaging machine control panel unit.

Mass flow rates:

rates counter in the packaging machine control panel unit.

MEATHDOLOGY:-

This research was conducted to Accounting and comparing volumes of damaged packages, quantity of product and electrical power losses in packaging processes from tetra brick aseptic packaging machine for two product including TP (mango juice 200 and 1000 ml) by using six different rates in plant (A) while two different product including VP 240 a (mango and apple juice) by using five different rates packaging system such as (mango juice 130, 200 gm and apple juice 130,200 gm) and two product including AUV (mango juice 200 and apple juice 200 ml) by using five packaging rates also in plant (B) in addition to one product including VP (apple juice 130 and 200 ml) by using five packaging rates in plant (C). On this study Quantity losses packages, juice and electrical power in plant

Data collection points:**The available data was divided in two groups:****1- recorded data 2- Measured data**

recorded of daily shafts packages product volume; packages losses product, worker shafts time and quantity of product losses.

Measured of tetra brick aseptic (TP), vole pack (VP) and Automatic vacuum filler/capper (AUV) packaging machine rates on different rates by packages rates counter on panel unit to determine the rates of damaged packages and product losses and comparing the rates of losses from mango and apple juice in different speed used by Packaging

machine to be arrived to the best speed which reduce the damaged packages and product losses.

These informations were analyzed .

Packaging Losses Calculations:-

Hanafy (2015) calculated the packaging losses with a model depend on packaging machine rates and packaging machine product.

1- The percent of damaged or losses packages or bottles was calculated using the following formula :

$$\% TP_L = \frac{TP_R - TP_P}{TP_R} \times 100 \longrightarrow (1)$$

where

TP_R = Packaging machine rates (pack. Or bottle/h)

TP_P = Packaging machine product (pack. Or bottle/h)

2- The percent of quantity juice losses

$$\% q_{ML} = \frac{q_M - q_{MP}}{q_M} \times 100 \longrightarrow (2)$$

where

q_M = Quantity of juice processed to package at the same machine rates (lit/h)

q_{MP} = Quantity of juice packaged at the same machine rates (lit/h)

3- Electrical power losses in packaging processes :-

The electrical power losses model used to calculate the electrical energy losses in packaging process depending on the percent of losses packages or bottles and the machine electrical power consumption during production with (k.w/hr) in different rates.

$$E_{PL} = TP_L \times M_{PL} \longrightarrow (3)$$

E_{PL} = Electrical power losses in packaging processes (k.w/hr)

M_{PL} = machine electrical power consumption during production (k.w/hr)

Table (1): Comparison between machine types electrical power consumption during production in plants (A,B and C).

PLANT NAME	MACHINE TYPES	M _{PL} (k.w/hr)
PLANT (A)	T.P 200 ml	22
	T.P 1000 ml	20
PLANT (B)	V.P 240	12.80
	A.U.V	18
PLANT (C)	V.P	12

RESULTS AND DISSCUATIO

The packaging process losses in plants (A, B and C):

The tetra pak packages,vole pack packages and glasses bottles damaged during produced three product were tetra pack, vole pack and glasses bottels juice and energy losses in this packages by different system in plants (A,B and C) where determined and compared in different machine rates.

1-Packages losses from tetra brick aseptic packaging machine in plant A:

Fig.(4 and 5) showed the damaged packages and losses of mango juice by tetra brick aseptic packaging machine for packaging UHT mango juice in plant A in tetera brick aseptic prortion packages volumes of 200 ml and 1 liter under six speeds of packaging. It is noticed that percentage of damaged packages were 3%, 1.10%, 3.20%, 2.80%, 1.60%, and 2% while the losses of mango juice with a percentage of were 3%, 3.28%, 2.98%, 3.04%, 3.45%, and 2.90% under packaging speeds of 6120, 6300, 6480, 6540, 6660 and 7680 respectively for volume of 200 ml and they were 2.50%, 1%, 1.31,% 3.30%, 1.40%, and 2.30% while the losses of mango juice with a percentage of were 4.60%, 1.03%, 2.22%, 2.25%, 1.28%, and 2.32% under packaging speeds of 5220, 5460, 5520, 5760, 5880 and 6120 respectively for volume of 1000 ml.From that it can be observed that the highest valu of damaged packages and lowest one were recorded in the case of using speeds of 6480 and 6300 for 200 ml and under speeds of 5760 and 5460 respectively for one litter volume.

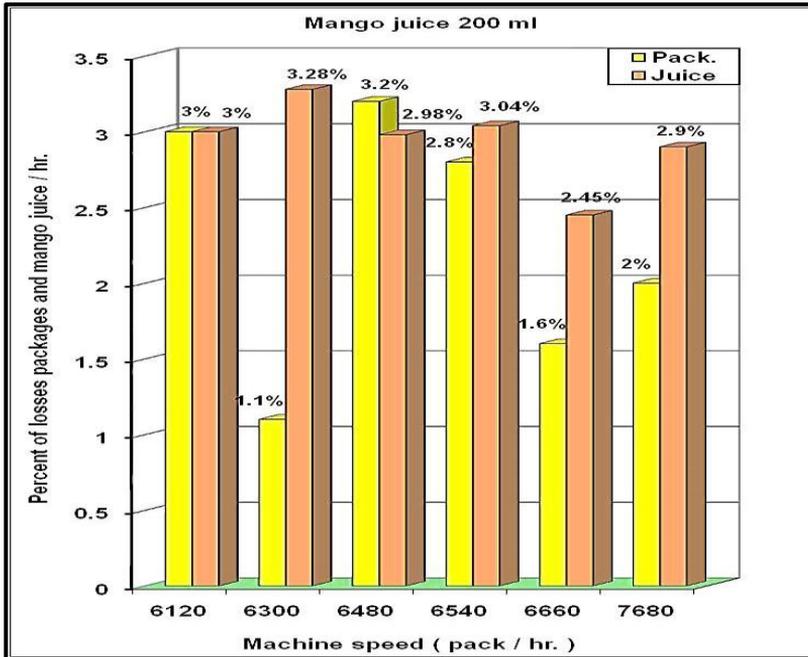


FIG.(4): Comparison between different rates of (Tp. 200 ml), damaged packages and losses mango juice in plant (A).

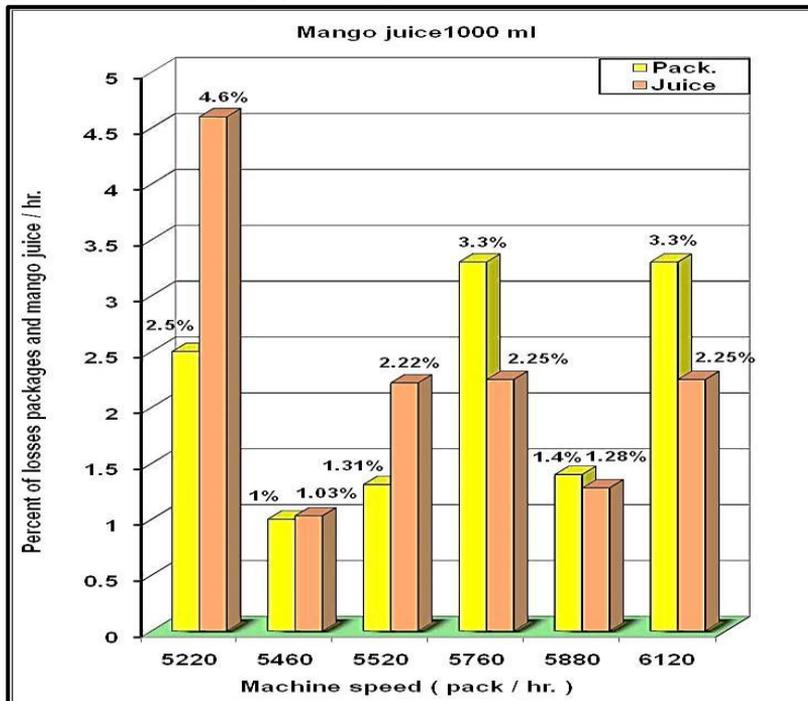


FIG.(5): Comparison between different rates of (Tp. 1000 ml), damaged packages and losses mango juice in plant (A).

2- Packages losses from Vole pack (240) packaging machine in plant (B):-

Damaged packages and losses juice by vole pack packaging machine 240 for packaging HTST mango and apple juice in plant B in vole pack packages packages weights were 130 gm and 200 gm using five speeds of packaging

2-1 Vole pack (240) packaging machine mango juice 130 and 200 gm :

From Fig.(6 and 7) it is cleared that the use of speed of 5160, 5400, 5460, 5520 and 5700 was accompanied with percentage of damaged packages were 5.14%, 2.43%, 1.43%, 1.56% and 2.26% for mango juice with volume of 130 gm and juice losses of 2.82%, 4.46%, 2.33%, 2.15% and 4.47% respectively.

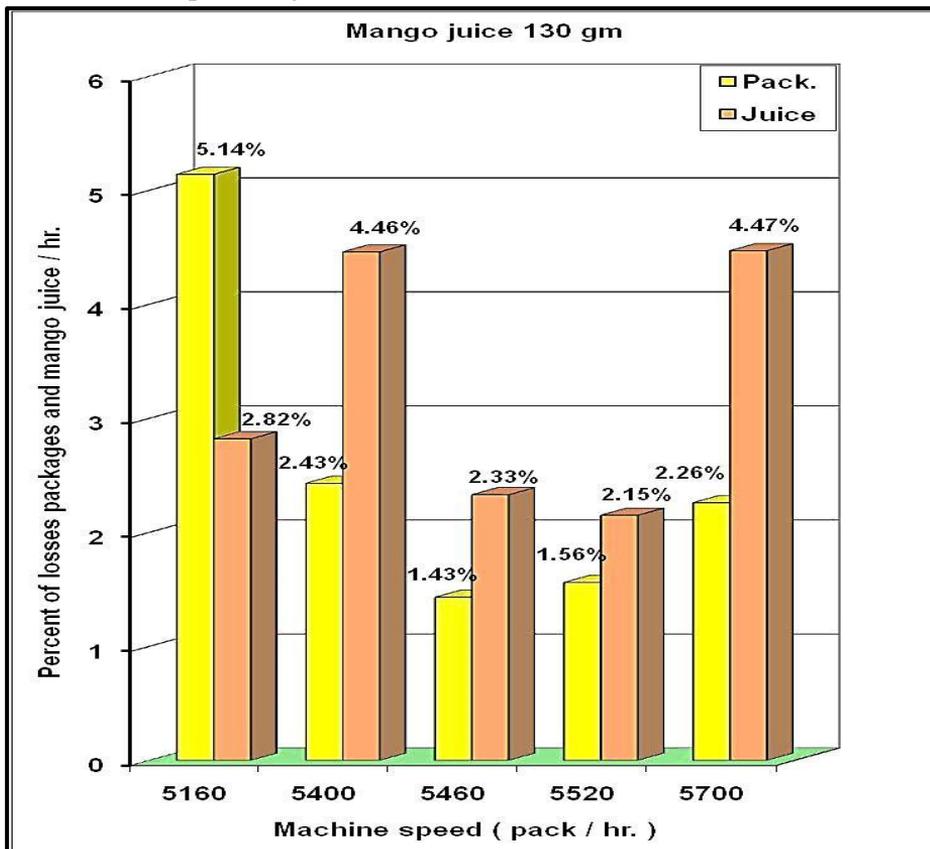


FIG.(5): Comparison between different rates of (VP. 240 , 130 gm), damaged packages and losses mango juice in plant (B).

Under the mentioned speeds 4560, 4800, 4860, 4920 and 5100 the damaged values were 4.80%, 1.81%, 1.75%, 3.46% and 5.22% while the losses recorded 2.81%, 1.40%, 4%, 1.43% and 3.90% respectively for volume 200 gm. It can be observed that the highest value of damaged packages and lowest one was accompanied with a speed were recorded in the case of using speeds of 5160 and 5520 for volume of 130 gm and under speeds of 5100 and 4860 for volume of 200 gm respectively.

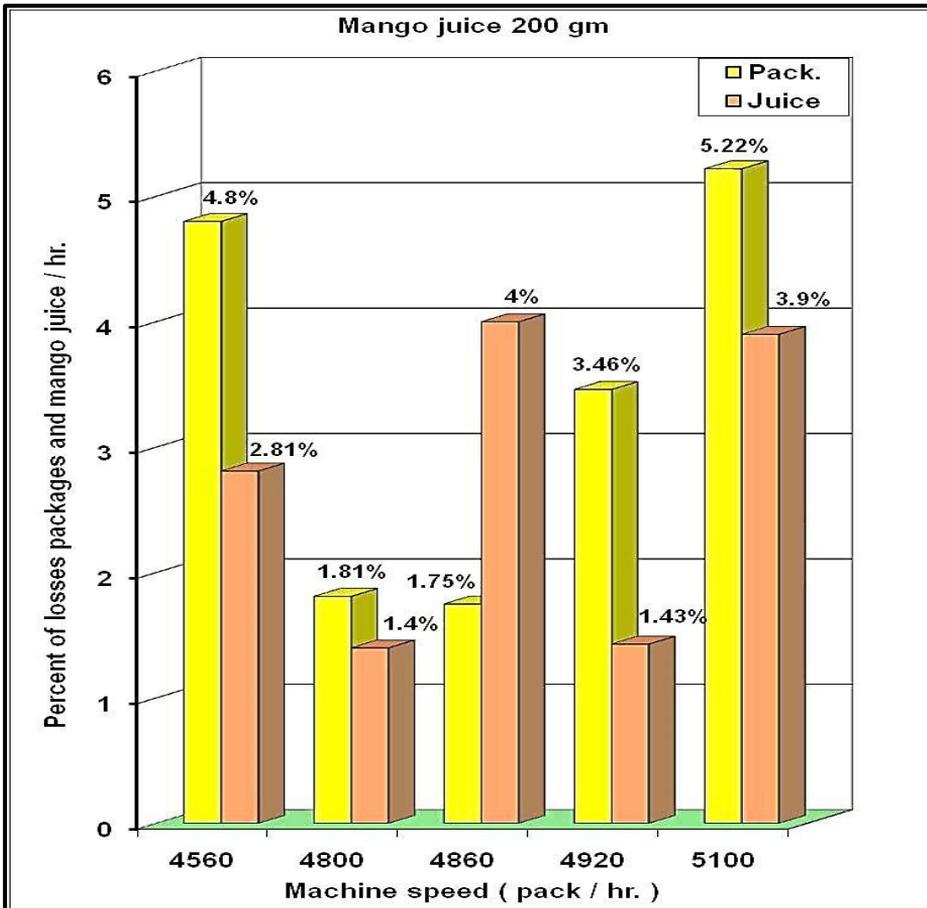


FIG.(6): Comparison between different rates of (VP. 240 , 200 gm), damaged packages and losses mango juice in plant (B).

2-2 Vole pack(240) packaging machine apple juice 130 gm and 200 gm in plant (B) :

Fig.(8 and 9) cleared that that the use of speed of 5220, 5460, 5520, 5580 and 5640 was accompanied with percentage of damaged packages were

2.16%, 1.87%, 1.55%, 1.80% and 2.14% for apple juice with volume of 130 ml and juice losses of 2.27%, 2.15%, 2.67%, 5.28% and 3.53% respectively..Under the mentioned speeds 4500, 4680, 4800, 5040 and 5640 the damaged values were 5.76%, 3.50%, 2.23%, 4.19% and 5.77% while the losses recorded 24.63%, 4.30%, 1.65%, 5.55% and 4.65% respectively for volume 200 gm. The highest valu of damaged packages and lowest one was accompanied with a speed were recorded in the case of using speeds of 5220 and 5520 for volume of 130 gm and under speeds of 5640 and 4800 respectively.

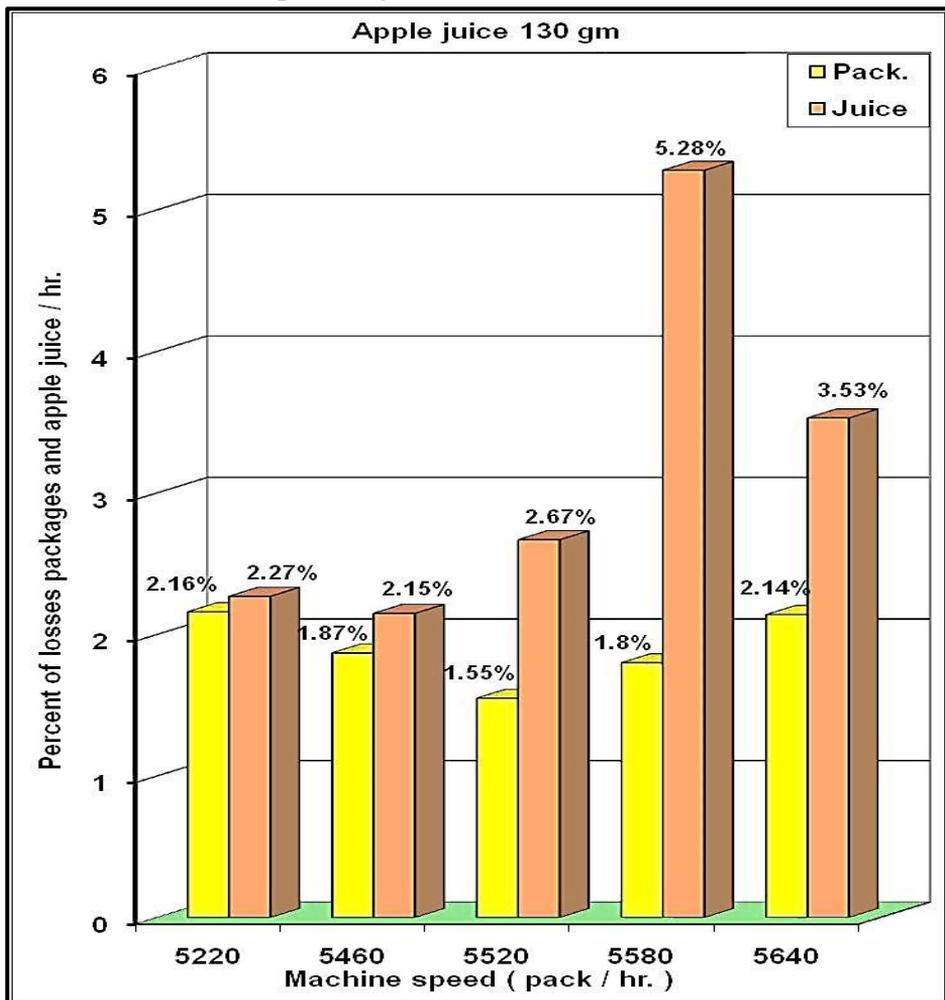


FIG.(8): Comparison between different rat of (VP. 240 , 130 gm), damaged packages and losses apple juice in plant (B).

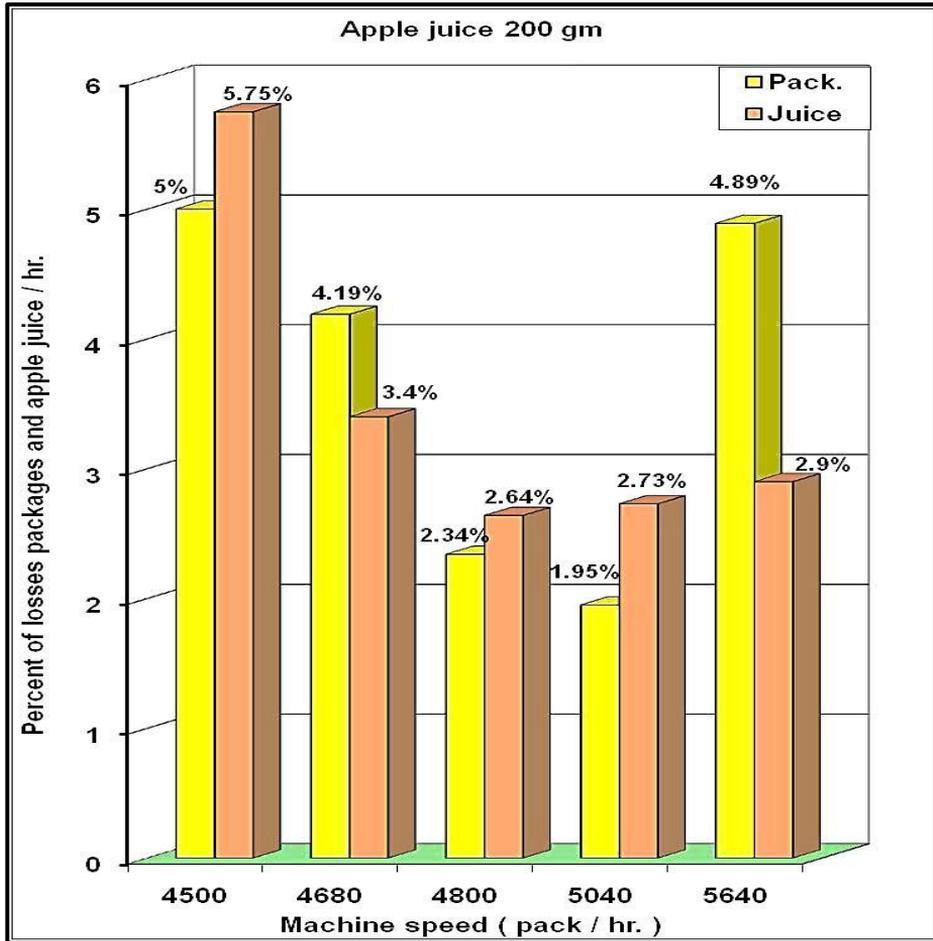


FIG.(9): Comparison between different rates of (VP. 240 , 200 gm), damaged packages and losses apple juice in plant (B).

2-3 Bottles damaged from Automatic vacuum filer/capper packaging machine in plant B:

Fig.(10 and 11) showed the damaged bottles, caps and losses of mango juice by automatic vacuum filer/capper packaging machine for packaging LTLT mango and apple juice in plant B in plant A in glasses bottles volumes were 200 ml under five speeds of packaging. It can noticed that percentage of damaged bottles were 1.17%, 1.15%, 0.82%, 0.63% and 0.51% while the percentage of damaged caps were 3.30%,4%,5.24%,7.24% and 8.28% in addition to losses of mango juice with percentage of 9.26%, 10%, 4.78%, 3.33% and 5.11% under packaging speeds of 3000, 3120, 3300, 3480 and

3540 respectively for mango juice 200 ml and they were 1.48%, 0.99%, 0.58%, 0.48% and 0.44% while the percentage of damaged caps were 3.81%, 5.65%, 6.04%, 6.23% and 6.53% in addition to losses of apple juice with percentage of 12.33%, 5.70%, 3.92%, 5.08% and 2.65% under packaging speeds of 3180, 3240, 3300, 3360 and 3420 respectively for apple juice 200 ml. From that it can be observed that the highest value of damaged bottles and lowest one were recorded in the case of using speeds of 3000 and 4860 for mango juice 200 ml and under speeds of 3180 and 3420 respectively for apple juice 200 ml.

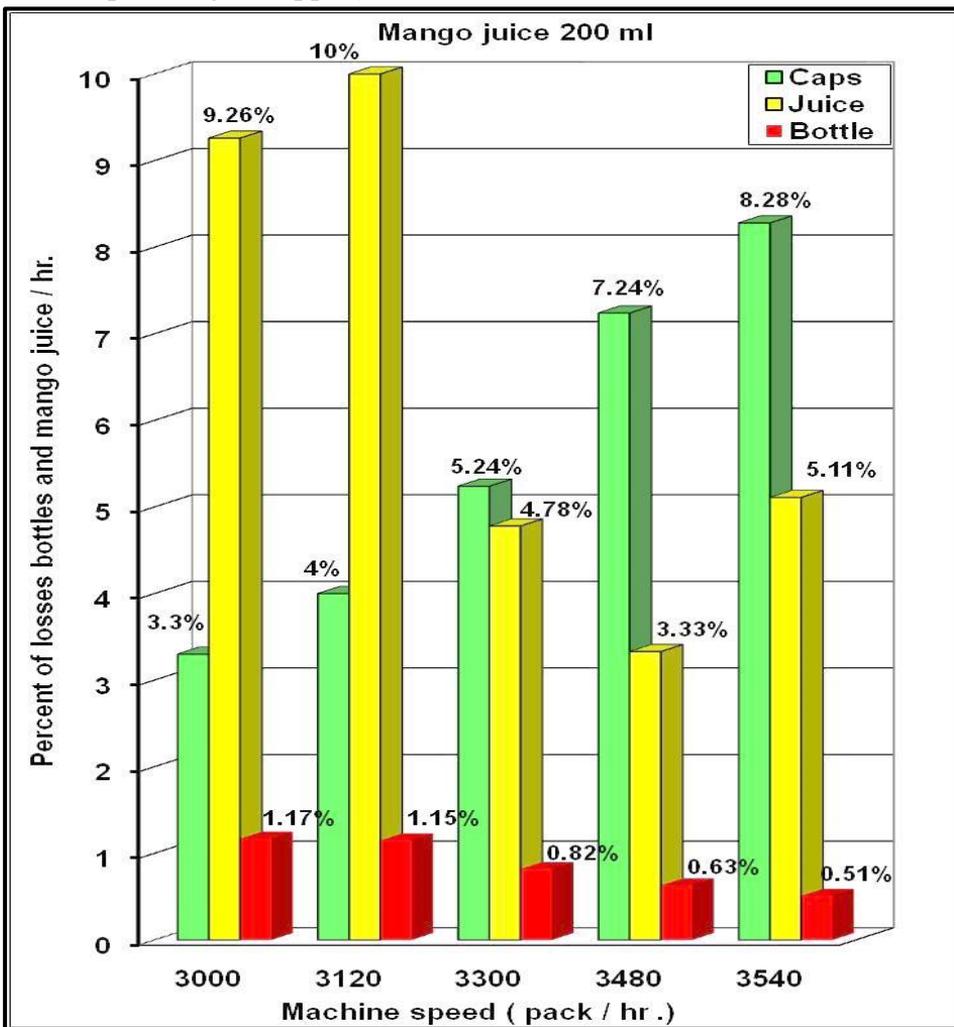


FIG.(10): Comparison between different rates of (AUF. 200 ml), damaged bottles and losses mango juice in plant (B).

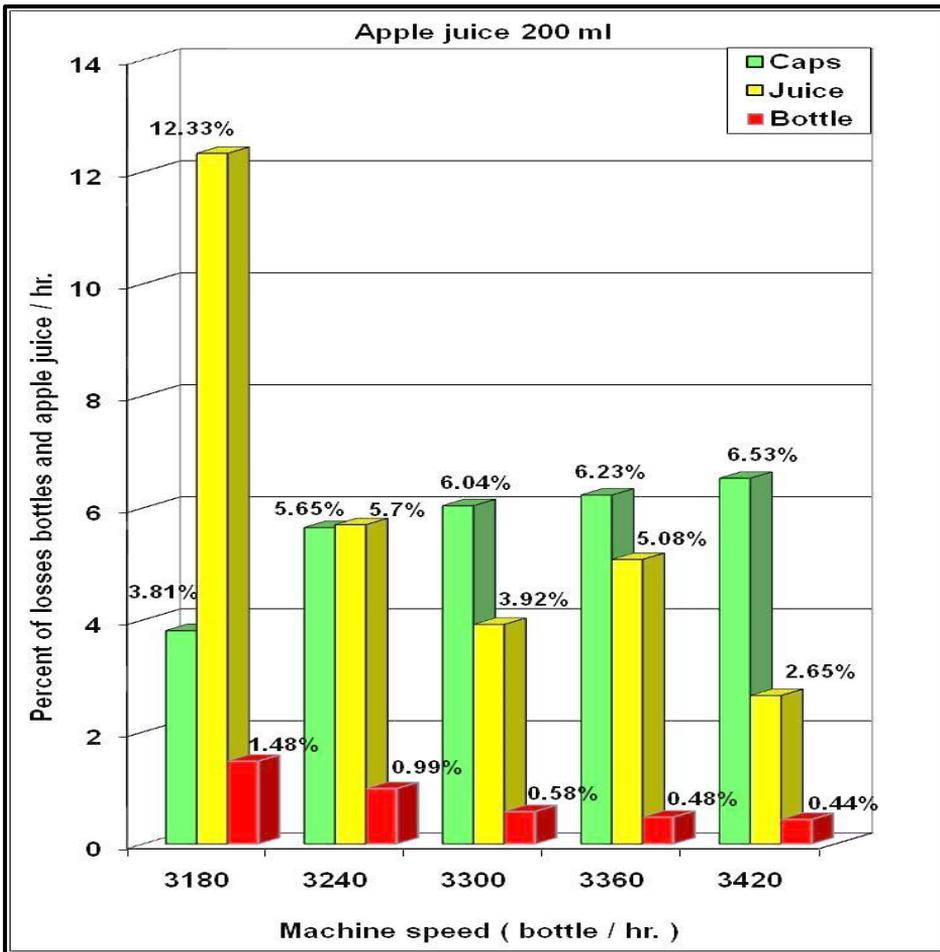


FIG.(11): Comparison between different rates of (AUF. 200 ml), damaged bottles and losses apple juice in plant (B).

3- packages losses from Vole pack packaging machine in plant (C):

Fig.(12 and 13) showed the Damaged packages and losses juice by vole pack packaging machine packaging HTST apple juice in plant C in vole pack packages volumes were (130 ml and 200 ml) using five speeds packages for packaging. It is noticed that percentage of damaged packages were 3.90%, 3.60%, 1.02%, 1.39% and 2.03% while the losses of apple juice with a percentage of were 3.97%, 3.80%, 2.12%, 1.15% and 3.37% under packaging speeds of 3000, 3060, 3240, 3600 and 3840 respectively for volume of 130 ml and they were 3360, 3420, 3540, 3600 and 3720 while the losses of apple juice with a percentage of were 3.22%,

2.96%, 1.76%, 2.36% and 1.92% under packaging speeds of 3360, 3420, 3540, 3600 and 3720 respectively for volume of 130 ml. From that it can be observed that the highest value of damaged packages and lowest one were recorded in the case of using speeds of 3000 and 3240 for 200 ml and under speeds of 3360 and 3540 respectively for 200 ml volume.

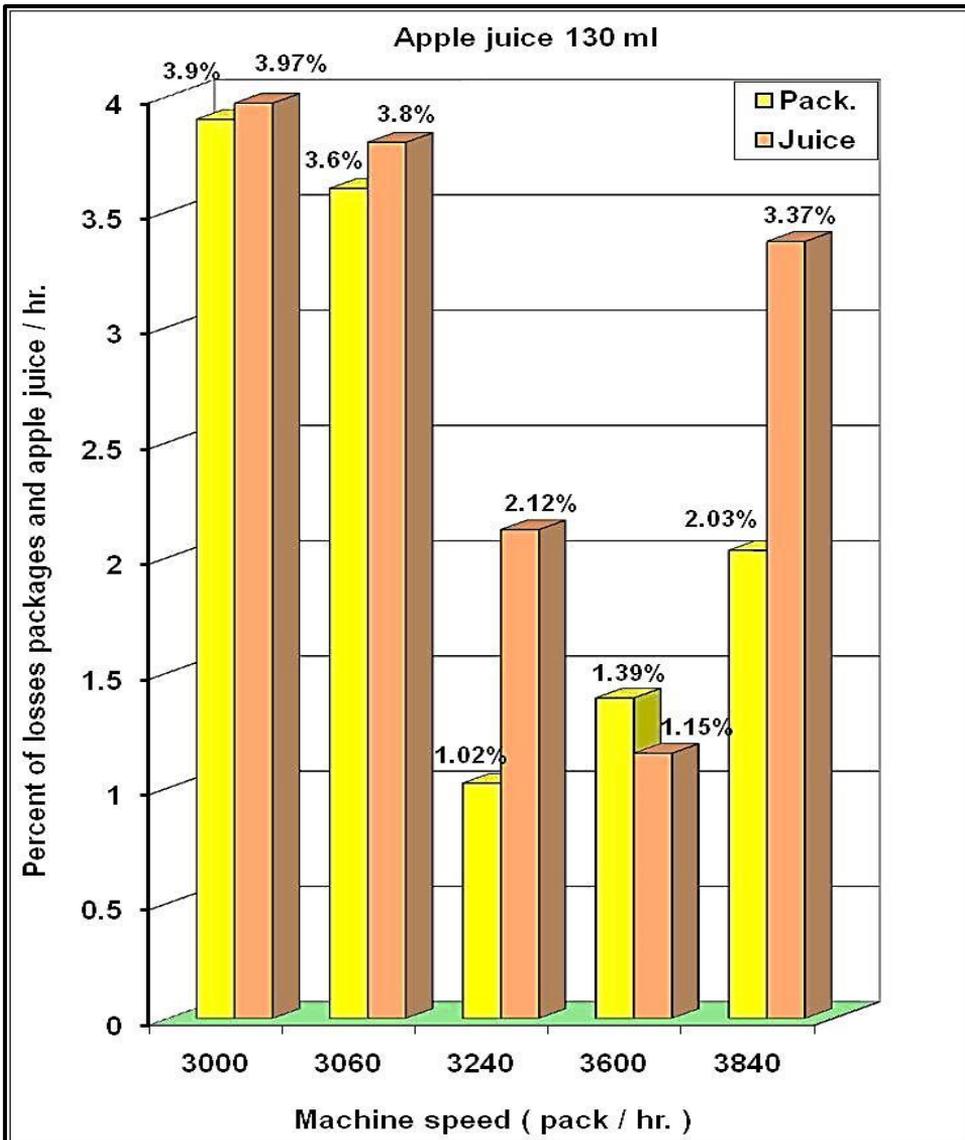


FIG.(12): Comparison between different rates of (VP.130 ml), damaged packages and losses apple juice in plant (C).

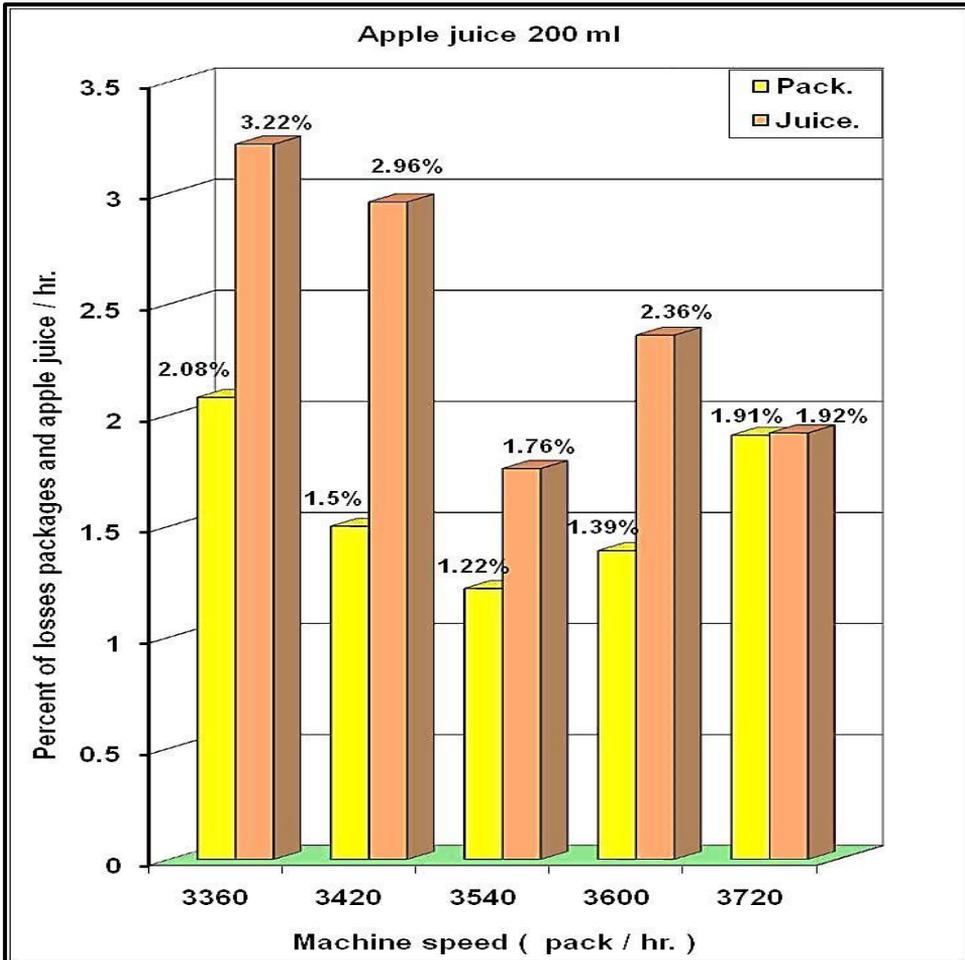


FIG.(13): Comparison between different rates of (VP. 200 ml), damaged packages and losses apple juice in plant (C).

CONCLUSION

To reduce the percentage of damaged package process and losses juice, the system of package should be conducted under package speeds ranged from 6660 to 6300 and from 5460 to 5880 for tetra pack system 200 and 1000 ml in plant A respectively while it should be from 5460 to 5520 and from 4800 to 4920 for VP.240 mango juice 130 and 200 gm, and from 5460 to 5520 and from 4800 to 5040 for VP.240 apple juice 130 and 200 gm and from 3480 to 3540 and from 3300 to 3420 for AUV mango and apple juice 200 ml in plant B respectively, and finally it should be from

3240 to 3600 and from 3540 to 3600 for VP. apple juice 130 and 200 ml, in plant C respectively.

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الملخص العربي

تقييم و مقارنة فواقد تعبئة العصير بمعدلات وانظمة مختلفة فى ثلاثة مصانع للعصائر

د. وليد محمد حنفى شحاته*

استهدف هذا البحث تقييم ومقارنة عبوات وزجاجات العصير المفقودة و كمية العصير المفقودة فى ثلاثة مصانع للعصائر هى (A,B,C) وذلك باستخدام معدلات وانظمة مختلفة للتعبئة حيث استخدم سنة معدلات للتعبئة فى مصنع (A) بينما استخدم خمسة معدلات فى كلا من مصنع (B) و (C) وذلك أثناء عملية تعبئة العصير بواسطة ماكينة التتراباك وماكينة الفولباك وماكينة التعبئة فى زجاجات وذلك من خلال تقييم ومقارنة العبوات التالفة و كذلك كمية فواقد المنتج أثناء عملية التعبئة للعبوات ذات الاحجام المختلفة وجرى هذا البحث والتجارى بمدينة العاشر من رمضان بثلاثة مصانع هى جرين لاند وطيبة وبيلا فى الفترة من يناير الى فبراير سنة ٢٠١٦.

و قد تبين من النتائج المتحصل عليها كل مما يأتى :

- كانت نسبة العبوات التالفة عند معدلات تعبئة مختلفة لماكينة التتراباك عبوة /الساعة لعبوات أحجام (عصير مانجو ٢٠٠ملى، عصير مانجو ١٠٠٠ملى) بنسبة تتراوح من و إلى (١.١٠~٣.٢٠) % ، (١.٣٠~٣.٣٠) % بينما نسبة كمية العصير المفقودة تتراوح من و إلى (٢.٤٥~٣.٢٨) % ، (١.٠٣~٤.٦٠) % والمعدل الأمثل للتعبئة كان (٦٦٦٠ و ٦٣٠٠) ، (٥٤٦٠ و ٥٨٨٠) عبوة / الساعة فى مصنع A على الترتيب.

- بينما كانت لماكينة الفولباك ٢٤٠ عبوة /الساعة لعبوات أحجام (عصير مانجو ١٣٠ جم ، عصير مانجو ٢٠٠جم) بنسبة تتراوح من و إلى (١.٤٣~٥.١٤) % ، (١.٧٥~٥.٢٢) % بينما نسبة كمية العصير المفقودة تتراوح من و إلى (٢.١٥~٤.٤٧) % ، (١.٤٠~٤) % والمعدل الأمثل للتعبئة كان (٥٤٦٠ و ٥٥٢٠) ، (٤٨٠٠ و ٤٩٢٠) عبوة / الساعة فى مصنع B على الترتيب.

بينما كانت لماكينة الفولباك ٢٤٠ عبوة /الساعة لعبوات أحجام (عصير تفاح ١٣٠ جم ، عصير تفاح ٢٠٠ جم) بنسبة تتراوح من و إلى (١.٥٥~٢.١٦) % ، (٢.٢٣~٥.٧٧) % بينما نسبة كمية العصير المفقودة تتراوح من و إلى (٢.١٥~٥.٢٨) % ، (١.٦٥~٥.٥٥) % والمعدل الأمثل للتعبئة كان (٥٤٦٠ و ٥٥٢٠) ، (٤٨٠٠ و ٥٠٤٠) عبوة / الساعة فى مصنع B على الترتيب.

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- وكانت لماكينة تعبئة الزجاجات زجاجة /الساعة لعبوات أحجام (عصير مانجو ٢٠٠ مللى، عصير تفاح ٢٠٠ مللى) بنسبة تتراوح من و إلى (٠.٥١~١.١٧) %، (٠.٤٤~١.٤٨) % بينما كانت نسبة الأغذية التالفة تتراوح من و إلى (٤.٣٠~٨.٦٨) %، (٣.٨١~٦.٠٤) % اما نسبة كمية العصير المفقودة تتراوح من و إلى (٣.٣٣~١٠) %، (٢.٦٥~١٢.٣٣) % والمعدل الأمثل للتعبئة كان (٣٤٨٠ و ٣٥٤٠)، (٣٤٢٠ و ٣٣٠٠) عبوة / الساعة فى مصنع B على الترتيب.

- و كانت لماكينة الفولباك عبوة /الساعة لعبوات أحجام (عصير تفاح ١٣٠ مللى، عصير تفاح ٢٠٠ مللى) بنسبة تتراوح من و إلى (١.٠٢~٣.٩٠) %، (١.٢٢~٢.٠٨) % بينما نسبة كمية العصير المفقودة تتراوح من و إلى (١.١٥~٣.٩٧) %، (١.٧٦~٣.٢٢) % والمعدل الأمثل للتعبئة كان (٣٢٤٠ و ٣٦٠٠)، (٣٥٤٠ و ٣٦٠٠) عبوة / الساعة فى مصنع C على الترتيب.