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Factors Affecting Productive and Economic Efficiency of Hy-Line Layer Breed Under Egyptian Condition

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ABSTRACT

The present study was conducted to explore the effects of some factors affecting the productive and economic efficiency of Hy-Line layer breed in El-Menofia governorate**.** Data was collected from accurate records present in the farms and from structural questionnaire method during period from 2000 to 2018 on 29 cycles. The aim of this study is to determine and highlight the most important factors affecting the productive efficiency of Hy-Line breed and their profitability under Egyptian conditions. The study revealed that forced molting had a significant effect ($P<0.05$) on productive efficiency parameters. Highest values of all productive and economic efficiency parameters as feed amount, total egg number, total return and net profit were in molting cycles (75.71, 530.29, 368.88and 69.81 LE, respectively) compared to non-molting cycles (46.56, 351.07, 284.95 and 48.31 LE, respectively). Regarding to year effect, year non significantly affected total feed amount and total egg production, lowest value of total feed amount and total egg production obtained in year after 2016. Mortality percent significantly differ among different years; highest value of mortality percent was 35.73 % in years between 2000 to 2008. While, all parameters of economics including different costs and return showed a significant difference ($P<0.05$) increase gradually with increasing years showed lowest value in 2000 to 2008 and highest value after 2016. So we concluded that prices of different inputs and output was increased in last few years and molting is economic factor for improvement productive and economic efficiency.

1. INTRODUCTION:

Poultry production has indeed become a leader in the livestock industry both in advanced management and technology. Behind that, poultry is an important source of animal protein, income, employment, industrial raw materials, manure, financial security (Tanko and Aji, 2017). Egyptian poultry industry has evolved into a very significant sector of Egyptian agricultural production; today the poultry industry in Egypt is predominantly market driven and has to find its way in the turbulent waters of global market (FAO, 2017), In last recent year the demand of egg, meat, and chicken is increasing at the increasing rate but the production has not been able to meet the requirement (Dhakal et al 2019).

Egg production become one of the most business interests (Amos, 2006), due to fast production of egg within 18 weeks (Okoli, 2006), that Overcome the demand and supply gap for animal protein intake (Olagunju, 2007).

On top of the hygienic attempts that rapidly increases the profitable rate is artificial molt, which induced natural component response of hen physiology. For this reason, induced molting has been suggested as the technically correct term (Berry, 2003). From economic point of view artificial molting give producers chance to reuse the flock in a new cycle of egg production saving time needed for rearing a new flock until reaching production, intermittent decreases in egg production and general productivity and during periods of low egg prices& marketing failure. While hygienically, avoiding diseases occurrence and reducing feed cost, vaccination and medication during the rearing period (McDaniel and Aske, 2000).

Egg laying cycle expanded about 12 months in chicken flock, while egg production begins at 18-22 weeks of age depending on the breed and season (Singh, 2019). Forced molting is a management tool and has been practiced for many years. It may involve different procedures, such as withdrawal of feed appeared successful to inducing molting, allowing a second or third cycle of production and maximizing post-molt egg production (Harms, 1990). So forced molting prevents age-related declines in egg production and eggshell quality (Hassanabadi & Kermanshahi, 2007).

Forced molting through feed withdrawal is an effective method to improve egg production, egg quality, fertility and increase period of egg production till 10 weeks (Moustafa et al., 2010), prevents age-related declines in egg production and eggshell quality(Hassanabadi & Kermanshahi, 2007).

The recent increase in the price of inputs (feed and chicks) adversely affected layer farming at local level. Forced molting of the laying hens to increase income and limit costs during second laying cycle has been practiced for many years in different parts of the world and could be feasible procedure to be adopted (Rafeeq et al., 2013). So the aim of this study is to determine effect of the most important factors including year, season and molting on the productive and economic efficiency of layer farms and their profitability under Egyptian conditions. Productive efficiency parameters including egg production, feed amount, feed conversion rate, feed conversion rate per dozen egg and mortality. The economic efficiency parameters including cost of production, gross return, net profit and studying the inter-relationships among different inputs, outputs and production parameters.

2. MATERIALS AND METHODS

This study was carried-out during the period extended from year 2000 to year 2018 on 29 cycles of Layer farms of Hy-Line layer breed in El Menofia government.

The data were collected from accurate records which available in the poultry farms of the study areas and also, by using the structured questionnaires methods according to (Farooq et al., 2002 and Ojo, 2003).

2.1. Types of data:

Production parameters and production resources:

That included feed intake (kg), average weekly egg production (number of saleable eggs collected), season (each cycle contain both summer and winter season as it extend for more than one year e.g the feed mount in the cycle include both summer feed amount plus winter feed amount), year, feed conversion rate (FCR) per egg mass, feed conversion rate (FCR) per dozen egg, age at beginning of laying, age of molting, time of molting, egg number/ layer, total egg production/hen and mortality percent.

2.2. Management of bird during molting:

A fasting period of 6-8 week was applied to cause molting. During the first two week each bird received about 30 gm/day ration and 5.5 gm crushed oyster shells and 2.5 gm limestone. Then increase amount of ration by 10gm after each week till 8^{th} week each bird received100 gm /day.

2.3. Production costs:

It included the fixed costs depreciation of the equipments. The depreciation rates for equipments on 5 years. And the variable costs such as the prices of drugs, vaccines, disinfectants, veterinary supervision, feed cost, rent, hen cost, labor cost and electricity (Sankhayan, 1983 and Atallah, 2000).

2.4. Production returns:

It included the returns from the total egg sales and hen sales at end of production cycle per /hen.

A. **Classification of data**

Factor	Class	Number of cycles
Year	2000- 2008	7
	2009-2016	9
	>2016	13
Forced molting	Molting cycles	10
	Non molting cycles	19

B. Economic and productive data calculation

1.
$$\text{Hen Housed Egg Production (North, 1984)} = \frac{total\ number\ of\ egg\ produced\ by\ flock}{total\ number\ of\ hen\ housed}$$

2.
$$\text{Feed conversion per dozen eggs (Abd El} - \text{wahed, 1998)} = \frac{kg\ of\ feed\ consumed\ \times 12}{total\ egg\ produced}$$

3. Average total costs per Egyptian pound = average fixed costs + average variable costs. (Soliman, 1985)
4. Average total variable costs per Egyptian pound = feed + hen value + labor + water and electricity + total veterinary management + rent.
5. Average fixed costs per Egyptian pound = equipment costs.
6. Average total returns per Egyptian pound = egg sales + hen sales
7. Average net profit = average total returns – average total costs. (Atallah, 1994)

The data were collected, arranged, summarized and then analyzed statistically using the computer program SPSS/PC+ "version 16" (SPSS, 2004).

2.5. Statistical analyses methods:-

The data were analyzed using relevant statistical methods of data analysis, namely:

2.5.1 Univariant, General linear model (GLM) for analysis of variance (ANOVA).

This statistical model was constructed to determine the effect of the season and years interaction, season and molting interaction on the productive and economic variables according to the following equation (Steel and Torrie, 1981).

$V_{Iop} = \mu + Y_I + S_o + M_p + (Yx\ S)_{io} + (M\ x\ S)_{po}$

Where

V_{Iop} = The studied and target variable.

μ = The overall mean of population.

Y_I = Effect of the I^{th} year(i.e 1=2000-2008, 2=2009-2016 and 3=>2016).

S_o= Effect of o^{th} season (i.e. 1= summer (21 March to 20 September) and 2=winter (21 September to 20 March)) .

M_p = Effect of p^{th} molting (i.e 1=non molting cycles and 2= molting cycles).

$(Yx\ S)_{io}$ = Effect of the interaction between I^{th} year range and o^{th} season (summer and winter).

$(M\ x\ S)_{po}$= Effect of the interaction between p^{th} molting range and o^{th} season (summer and winter).

Significance done using Duncan's multiple range test (DMRT) by MSTAT program.

2- **One way ANOVA**

It was done to determine means of variables among different years.

2.5.2. Independent sample t test

It was done to determine means of different variables among molting and non-molting cycles and significance done using two tail significance of T test.

3. RESULTS AND DISCUSSION

3.1. Effect of different years among different seasons on productive and economic efficiency :

Results in table (1) showed that feed amount, total egg number, feed conversion ratio and mortality percent showing non-significant difference among different seasons but feed amount and egg number show a significant difference among different years, higher feed amount (31.87kg) in years 2000-2008 and lower feed amount (25.14 kg) after 2016. Also, higher number egg production (ranged from 224.21 to 225.23 eggs) during 2000 to 2016 and lower egg number (183.86 eggs) after 2016. Those resulted agreed with Elnor (2006) who found that egg production percentage showed no significant difference among summer and winter. Also, Persia et al. (2003) stated that a non-significant differences in egg production caused by seasons. Contrary to other studies, Garces et al. (2001), Mashaly et al. (2004) and Yogeshpriya (2015) who reported that the highest egg production was in the winter and lowest in the summer in farms under intensive system of rearing. Seasonal variation is non-genetic factors influencing performance of poultry due to day-length and meteorological element as heat stress in summer that decrease egg production.

It is became clear that the adoption of improved management systems to reduce adverse effects of heat stress most especially in dry season months would enhance optimal performance of laying birds and all-year-round production of eggs of birds reared intensively.

Concerning to total mortality percent showed non-significant difference among different seasons but showed higher value in summer season than winter season among different years. While, there was a significant difference among different years, the lower value of mortality was 10.49 % in year after 2016.

Table (1): Effect of different years among different seasons on productive and economic efficiency.

Small litters significantly differ (P ≤ 0.05) within the same column among different seasons, while capital litter significantly differ (P ≤ 0.05) among different seasons.

Year	Season	Feed amount	Egg number	FCR	FCR (dozen egg)	Mortality	Egg sale	Feed cost
		Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE	Mean ±SE
2000-2008	**Summer**	28.84 ^{a}±3.04	211.56^{a}±13.68	2.14a±0.12	1.61±0.09	17.99^{a}±2.46	51.22^{b}±1.28	32.91^{b}±0.82
	Winter	34.89 ^{a}±1.63	236.86^{a}±4.96	2.35^{a}±0.09	1.77±0.08	17.74^{a}±1.40	58.93^{b}±4.55	41.49^{b}±2.65
	Average	**31.87 ^{A}±1.85**	**224.21^{A}±7.82**	**2.24^{A}±0.08**	**1.69^{A}±0.06**	**17.87^{A}±1.36**	**55.07^{C}±2.51**	**37.20^{C}±1.79**
2009-2016	**Summer**	30.21 ^{a}±3.26	221.14^{a}±24.76	2.25^{a}±0.04	1.65±0.03	17.36^{a}±1.89	142.76^{a}±27.05	102.07^{a}±19.33
	Winter	30.01 ^{a}±3.22	229.32^{a}±22.74	2.11^{a}±0.03	1.56±0.02	11.99^{a}±1.76	145.67^{a}±25.56	99.35^{a}±17.96
	Average	**30.11 ^{AB}±2.23**	**225.23^{A}±16.34**	**2.18^{A}±0.03**	**1.60^{A}±0.02**	**14.68^{A}±1.41**	**144.21^{B}±18.05**	**100.71^{B}±12.81**
>2016	**Summer**	25.56 ^{a}±2.34	187.47^{a}±17.21	2.24^{a}±0.05	1.64±0.04	11.38^{a}±2.11	194.66^{a}±18.56	133.65^{a}±12.80
	Winter	24.72 ^{a}±2.16	180.24^{a}±13.28	2.31^{a}±0.08	1.65±0.07	9.60^{a}±1.63	187.03^{a}±14.45	129.15^{a}±11.83
	Average	**25.14 ^{B}±1.56**	**183.86^{B}±10.67**	**2.27^{A}±0.04**	**1.64^{A}±0.04**	**10.49^{B}±1.32**	**190.84^{A}±11.55**	**131.40^{A}±8.55**

Table (2): Effect of forced molting among different seasons on productive and economic efficiency.

Cycles	season	Egg number	Feed amount	FCR	FCR (dozen egg)	Mortality %	Feed cost	Egg sales
		Mean±SE	Mean±SE	Mean ±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Non−molting	**summer**	168.62^{a}±7.85	22.51^{a}±1.13	2.19^{a}±0.05	1.61^{a}±0.04	13.21^{a}±1.70	89.12^{a}±10.72	129.02^{a}±15.08
	winter	182.46^{a}±10.20	24.05^{a}±1.48	2.21^{a}±0.05	1.59^{a}±0.05	11.07^{a}±1.45	89.82^{a}±9.54	132.87^{a}±12.93
	Average	**175.54^{B}±6.45**	**23.28^{B}±0.93**	**2.20^{B}±0.04**	**1.60^{B}±0.03**	**12.14^{B}±1.11**	**89.47^{A}±7.08**	**130.95^{A}±9.80**
Molting	**summer**	270.46^{a}±13.24	37.84^{a}±1.32	2.27^{a}±0.04	1.69^{a}±0.04	17.93^{a}±1.99	119.32^{a}±24.38	172.24^{a}±34.98
	winter	259.83^{a}±10.99	37.87^{a}±0.93	2.35^{a}±0.07	1.77^{a}±0.06	14.66^{a}±1.56	115.69^{a}±22.31	163.02^{a}±31.99
	Average	**265.14^{A}±8.46**	**37.86^{A}±0.79**	**2.31^{A}±0.04**	**1.73^{A}±0.03**	**16.29^{A}±1.29**	**117.50^{A}±16.09**	**167.63^{A}±23.09**

Small litters significantly differ (P ≤ 0.05)) within the same column among different seasons, while capital litter significantly differ (P ≤ 0.05) among different cycles.

Above result are in accordance with those obtained by Elnor (2006) who found that mortality rate in the DMRT showed no significant difference among summer and winter. Also Musharaf (1992) and Ali (2000) stated that mortality rate was higher in summer than winter.

Regarding to return from egg sales and feed cost showed significant difference among different years and seasons as higher egg sales found on year after 2016 (194.66 and 187.03 LE for summer and winter, respectively). While, lower value found during period from 2000 to 2008 (51.22 and 58.93 LE for summer and winter, respectively). Also, higher feed costs found on year after 2016 (133.65 and 129.15 LE for summer and winter, respectively). While, lower value found during period from 2000 to 2008 (133.65 and 129.15 LE for summer and winter, respectively). These result confirm those reported by Phommasack (2014) who found that Low price of eggs, high cost of production main constraint for poultry industry as the price of commercial feed, drugs and vaccine increase every year, while the price of eggs remain low, also in agreement with Strong et al. (2012) who said that egg price is affected by a number of factors as demand, seasonal variation factors. While, these results disagreed with Elnor (2006) who showed that winter is superior to summer in all layers performance parameters.

3.2. Effect of forced molting among different seasons on productive and economic efficiency

Results in table (2) clarified that total egg number, feed amount, FCR, mortality percent, feed cost and sales from egg showed non-significant difference among different seasons. Higher feed amount found on molting cycles during winter (37.87 kg) and the lowest found on non- molting cycles during summer (22.51kg) These results were in agreement with Elnor (2006) who showed that the feed intake increases in winter rather than in summer due to the decrease in temperature, while there is no significant differences as for as the feed conversion ratio among summer and winter.

Concerning to forced molting effect showed a significant difference among molting cycles and non- molting cycles as higher value of egg number, feed amount, FCR and FCR (dozen egg) and mortality percent found in molting cycles (265.14 egg, 37.86, 2.31, 1.73, 16.29%, respectively) compared to non- molting cycles (175.54, 23.28, 2.20.1.60 and 12.14, respectively).

While feed costs and sales from egg showed non-significant difference among different seasons and molting cycles, higher feed cost and egg sales in molting cycles compared to non−molting cycles. This results in agreement with Sharma and Gupta (2013) who found that the forced molting provide a tool to improve the production potential of the existing layer flock and as well as the economic efficiency**.**

We concluded that the decisions on molting must be based on the performance profile of commercial layers, approved methods of molting, and the demand for eggs at heavier weights. Producer need to develop ways and means to shorten the molt period and/or to change the time of molting to benefit from seasonal demand and corresponding egg prices (Flock and Anderson, 2016).

3.3. Effect of different years on productive and economic efficiency(hen/cycle)

Results in table (3) clarified that age of production showed a significant difference among different years was highest on 2000 to 2008 and lowest on 2009- 2016. Total feed amount and total egg production showed non-significant difference among different years and decreasing with increasing years after 2016, showed the lowest egg number and feed amount. Also, total egg production with higher in 2009-2016 than before year 2009 this result agree with FAOSTAT (2012) found that an increase in egg production in 2011 which was 5.8 billion eggs in comparison to 5.2 billion eggs in 2005.

Table (3): Effect of different years on productive and economic efficiency (Hen/Cycle).

Items	2000-2008	2009-2016	>2016
	Mean±S.E	Mean±S.E	Mean±S.E
Age at production	21.43^{a}±0.20	18.89^{c}±0.26	20.69^{b}±0.17
Total number of production weeks	93.14^{a}±6.82	87.89^{a}±9.47	70.23^{a}±6.88
Total mortality percent	35.73^{a}±2.94	29.36^{ab}±2.30	20.98^{b}±3.53
Total feed amount	63.73^{a}±4.51	60.22^{a}±6.25	50.28^{a}±4.33
Total egg number	448.42^{a}±12.10	450.46^{a}±45.47	367.71^{a}±29.85
FCR per total egg mass	2.25^{a}±0.10	2.18^{a}±0.02	2.26^{a}±0.05
FCR per dozen egg	1.69^{a}±0.08	1.60^{a}±0.01	1.64^{a}±0.04
Feed cost	90.35^{b}±8.00	201.42^{a}±37.08	262.81^{a}±23.73
Hen cost	23.43^{c}±0.61	41.00^{b}±3.67	58.46^{a}±0.67
Total veterinary management	3.70^{c}±0.09	6.88^{b}±0.76	10.01^{a}±0.23
Labor	0.42^{c}±0.04	0.62^{b}±0.05	0.98^{a}±0.04
Electricity and water	0.40^{c}±0.03	0.66^{b}±0.05	0.99^{a}±0.02
Rent	1.38^{c}±0.05	1.56^{b}±0.04	1.97^{a}±0.05
Total variable cost	119.67^{b}±8.56	252.14^{a}±41.03	335.22^{a}±24.36
Equipment	0.42^{c}±0.04	0.64^{b}±0.05	1.03^{a}±0.05
Total costs	120.09^{b}±8.60	252.78^{a}±41.07	336.25^{a}±24.40
Egg sale	128.38^{b}±5.82	288.43^{a}±52.11	381.68^{a}±32.36
Hen sale	11.71^{c}±0.31	20.50^{b}±1.84	29.23^{a}±0.33
Total return	140.10^{b}±6.04	308.93^{a}±53.71	410.91^{a}±32.55
Net Profit	20.01^{b}±3.41	56.15^{ab}±14.48	74.66^{a}±11.57

Means within the same rows carrying different superscripts are significant at ($P \leq 0.05$) within the same row.

Table (4): Effect of forced molting on productive and economic efficiency (Hen/Cycle).

Items	Non−molting	Molting
	Mean±S.E	Mean±S.E
Age at production	20.37^{a}±0.30	20.20^{a}±0.33
Total number of production weeks	65.21^{b}±3.31	111.70^{a}±3.07
Total mortality percent	24.28^{b}±2.66	32.59^{a}±3.09
Total feed amount	46.56^{b}±2.19	75.71^{a}±2.05
Total egg number	351.07^{b}±16.10	530.29^{a}±21.85
FCR per total egg mass	2.19^{b}±0.04	2.30^{a}±0.05
FCR per dozen egg	1.60^{b}±0.03	1.72^{a}±0.04
Feed cost	178.94^{a}±19.66	246.18^{a}±42.57
Hen cost	46.11^{a}±3.51	41.70^{a}±5.23
Total veterinary management	7.56^{a}±0.65	7.42^{a}±1.00
Labor	0.74^{a}±0.06	0.71^{a}±0.10
Electricity and water	0.77^{a}±0.06	0.70^{a}±0.10
Rent	1.73^{a}±0.06	1.63^{a}±0.11
Total variable cost	235.86^{a}±23.46	298.34^{a}±48.86
Equipment	0.78^{a}±0.06	0.74^{a}±0.11
Total costs	236.64^{a}±23.52	299.08^{a}±48.96
Egg sale	261.90^{a}±27.65	348.03^{a}±61.67
Hen sale	23.05^{a}±1.76	20.85^{a}±2.62
Total return	284.95^{a}±29.17	368.88^{a}±64.23
Net Profit	48.31^{a}±7.88	69.81^{a}±16.92

Means within the same rows carrying different superscripts are significant at ($P \leq 0.05$).

Mortality percent decreasing with increasing years, showed highest value (35.73%) in 2000 to 2008 and lowest after 2016 (20.98%). While all parameters of economic efficiency including different costs and returns showed a significant difference (P<0.05) and increased gradually with increasing years showed the lowest value in 2000 to 2008 and the highest value after 2016, this results in agreement with Stats SA (2017) reported that Total sales from egg increased at level 6.1% annual increase and culled hens increase annually by 2.8%. Also Ahlam El Nagar and Ibrahim (2007) reported that The value of poultry production (meats and eggs) rose from LE 3.1 billion in 1995/1996 to almost LE 9.7 billion in 2004/2005. Also the prices of poultry decrease between 2005 to 2006 due to Avian influenza disease and consumer demand decrease on poultry products and the high production costs due to Egypt imported ingredient used for feed formulation of poultry as protein concentrated, and feed additives so lead to increase feed costs (Hosny, 2006), feed price was found to be the factor which has the highest negative impact on the profitability while The egg sale price had a high positive impact on profitability (Altahat et al., 2012 and Farooq et al., 2001b).

Variability in cost components is mainly attributable to management conditions (Farooq et al., 2001a), size of the operation (Ames and Ngemba, 1987 and Kumar and Mahalati, 1998) management conditions and feed efficiency (Elwardany et al., 1998).

3.4. Effect of forced molting on productive and economic efficiency(hen/cycle)

Results in table (4) showed that total number of production weeks, total mortality percent, total feed amount, total egg number and feed conversion ratio showed a significant difference (P<0.05) and higher value found in molting cycles compared to non−molting cycles. These results in agreement with Hassan and Ali (2018) who reported that there is a significant increase in egg production of molting group compared with control group, the positive effect of molting group due to losing of adipose tissue around the female reproductive system and the rest period after the molting process (Mohammed and Ali, 2015), also molting process is effecting on the reproduction system by Thyroid gland hormones, which result increasing the reserves of nutrients in the body of chickens, and the replacement of feathers. (Pešic et al., 2016) also due to the rejuvenation of reproductive tracts and other digestive organs after the molting procedure (Sapkota et al., 2018).

Regarding to Mortality pattern was higher in molting cycle compared to the regular cycle. This was due to many cases of cannibalism along with many other reasons. Cannibalism was seen due to starvation (Sapkota et al., 2018).

Moreover, feed cost, total variable cost, total cost, return from egg sales, return from hen sales, total return and net profit were higher in molting cycles compared to non–molting cycles but there was non-significant (P>0.05). These result in agreement with Altahat et al. (2012) who said that higher length of production cycle, higher egg sale value and higher laying percentage are associated with higher profitability. Also, Sharma and Gupta (2013) found that forced molting provide a tool to improve the production potential of the existing layer flock and as well as the economic efficiency. Also Aygun (2013) and UEP (2016) found that Forced molting is a management tool adopted by poultry farmers to give the rest at the end of a long period of egg production and prolong the productive life of flock to 110 weeks or longer. Moreover the practice of molting continued to increase and spread widely in the most of egg production countries of the world with the time as a tool to renew the spent hens, (Bell, 2003). And the induced molting reduces the production cost compared with the replacement of the flock with younger new flock (Holt, 2003).

The economic benefits of molting are obvious if molted hens are compared to non-molted hens kept to the same age of 109 weeks. Molting hens produced more egg income over pullet and feed cost during the first 52 weeks of production (Flock and Anderson, 2016). Regarding to result of Profit was greater during the molting group in relation to the regular production group, which was caused by lower input costs and a larger number of eggs (Spasic et al., 2011). Regarding to total return was higher in the molting cycle compared to the regular cycle of production. (Pešic et al., 2016).

So the decision of using a force molting program depends on many factors such as, price of replacement with new flock, egg quality, and egg price, feed cost and employed molting method (Garcia et al., 2001 and Reddy et al., 2008).

From the obtained results we can conclude that for providing maximum output and profitability of the cycle must be managed effectively, molting could improve egg production and profitability of layer farm represented in total return and net profit of layer.

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