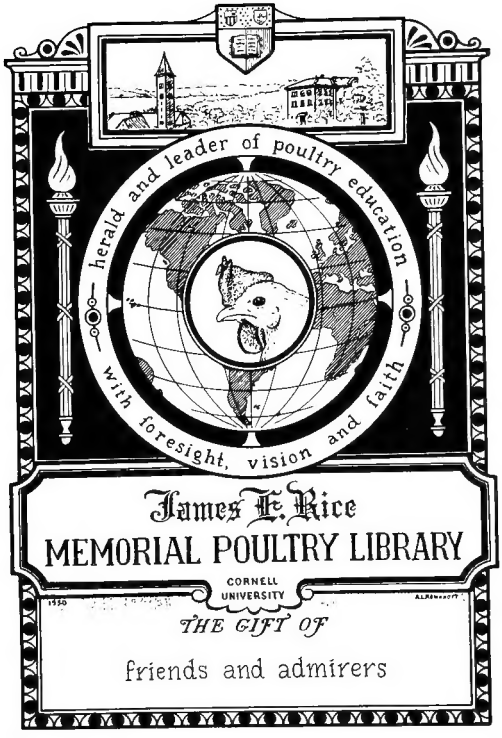

POULTRY BULLETIN

THE INFLUENCE OF YEAST UPON FERTILITY AND HATCHABILITY OF HENS' EGGS

BY

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The Influence of Yeast Upon Fertility and Hatchability of Hens' Eggs*

There is probably no one question, the solution of which is more essential to satisfactory progress in the poultry industry today than that of increasing the fertility and hatchability of hens' eggs.

THE FERTILITY PROBLEM

Careful observations made over long periods of years by poultry research workers at our various agricultural colleges and experiment stations and by thousands of commercial poultry men who hatch extensively, have established the undisputed fact that fertility of hatching eggs is influenced by seasons of the year, by breed, by age of birds, and by general feeding and managerial conditions. Poor fertility creates a big economic question by virtue of the loss resulting from infertile eggs placed in incubators. To the commercial poultry man producing baby chicks on an extensive basis the fertility problem is especially acute for in the course of a season the success of his business is going to depend upon the efficiency of his hatching operations. Poor fertility cuts down the hatches and hence the profits very materially.

To the breeder of exhibition standard bred poultry the problem is of just as great significance. To the farm poultry raiser the question is not as acute because under farm conditions chicks are hatched later in the season when normal fertility is at its best, but even under these ideal conditions, it is a factor in his success with the hens.

It has been said by many poultry authorities that poultry-keeping to be successful involves, first of all, the efficient reproduction of the flock. This becomes a very important factor with poultry because of their relatively short life, which means that large numbers of young must be hatched and reared each year to replace the older hens which have passed their prime as egg producers.

Season influences fertility in the following manner: the spring months are the normal reproduction period for poultry. It is during April and

*These experiments were planned by Prof. Harry R. Lewis, formerly Professor of Poultry Husbandry, New Jersey State University, and conducted at Lewis Farms at Davisville, Rhode Island, under his personal supervision.

May that fertility always runs highest. At other seasons of the year fertility runs materially lower depending largely upon conditions under which the birds are kept and the extent to which they have been forced for egg production. It is a known fact among hatcherymen of the country that the beginning of the hatching season, along in February, fertility will run fair, then most every year there comes a time along in the early part of March when there comes a slump in fertility and hatches fall off proportionately. This slump is followed in the course of a few weeks by a rapid rise in fertility to the point of normal spring conditions. To eliminate this late winter slump has been the object of hatcherymen for many years.

The factor of breed of birds materially influences fertility in that the lighter, active, Mediterranean breeds always produce a much higher fertility than the heavier, less active, American breeds. The poorest fertility of all comes from the heavy, slow-moving, inactive, Asiatic breeds.

The age of birds influences normal fertility materially in that the fertility from mature pullets usually runs higher than that from yearling or older hens, especially is this true if the pullets have not been forced for an exceptional egg production previous to the hatching season. The reason for the general slump in fertility from yearling or aged hens is the fact that they are not usually allowed to recover fully from the effects of previous periods of heavy laying.

The amount of egg production materially influences fertility in the following manner. Birds which have been heavily forced for egg production, especially for some time previous to the period of saving eggs for hatching have apparently laid out of their system and out of their body some unknown yet very essential factor which is essential in the production of fertile eggs. Birds just coming into production seem to be able to produce a far higher fertility, probably as a result of an extended rest period which has allowed them time to accumulate in their system an abundant supply of this unknown factor which is apparently so essential for high fertility and strong germs. A general statement covering this condition can well be expressed as follows:—breeding birds just coming into production, well fleshed with an abundance of yellow pigment produce a very large percentage of fertile eggs with strong germs, while hens which have been laying heavily for a long time, which are not supplied with large quantities of fat, and from which the pigment has been largely bleached produce eggs of inferior hatching qualities due to low fertility and weak germs.

From the above discussion it can be readily seen that fertility is dependent in large part upon managerial conditions. The forcing of breeders for heavy egg production for a long time previous to the hatching season, by the use of heavy protein mashes, artificial illumination and other known stimulating methods is surely a detriment to fertility.

THE HATCHING PROBLEM

The previous discussion dealing with factors influencing fertility applies equally as well to the problem of hatchability. In this way, it has been demonstrated scientifically over and over again that hatchability is in the main directly in proportion to fertility; that is, a lot of eggs showing a high fertility almost always possess strong germs and hatch well while any lot of eggs showing low fertility possess many weak germs and hatch poorly. It has been further demonstrated that chicks from good hatches are usually far superior to chicks from poor hatches. That is, where the breeders are in good physical condition and are capable of producing fertile eggs with strong germs which hatch well, the resulting chicks are bound to be superior individuals; where on the other hand, weak chicks usually result where the parent stock is weak and where a considerable percentage of eggs set are infertile with many weak germs, resulting in a poor hatch. These conditions are generally accepted facts among hatcherymen.

The percent of hatch bears a very definite relation to profit in any incubator operation. In the production of baby chicks commercially, sales are usually planned on the basis of 75 to 80% fertility and a 50% hatch. These conditions bring about just a normal margin of profit. Where it is possible through improved managerial conditions to get a higher fertility and a higher percent of hatch the increased number of chicks secured result in a very marked increase in net returns. In addition the resulting chicks are apt to be stronger, and of course give better satisfaction to the purchaser. Likewise on the commercial egg farm, the breeding establishment or the farm flock increased hatches materially reduce the cost per chick. One can readily see, therefore, the important relation between fertility and hatchability on the one hand and the general efficiency and profitableness of the business on the other hand.

SOME RESULTS FROM YEAST

Being personally concerned with the importance and practical application of this problem the writer has, for a number of years, been experimenting with various feeding methods and various managerial practices which might have a practical and commercial application in overcoming some of the low fertility and poor hatches which are so common at certain times of the year. So it was that during the late winter and early spring in 1924 a rather extensive observation was made with yeast as a possible factor which would have some practical bearing on this question.

This experiment was conducted purely on a commercial basis with an eye to commercial results only. The yeast for this experiment was purchased from a local supply house. No effort was made to communicate with yeast manufacturers or to interest them in the fact that the experi-

ment was contemplated. Fleischmann's Pure Dry Feed Yeast was chosen as a source of yeast supply. First—because of its wide distribution and availability. Second—it was chosen because of the fact that it was a pure yeast product carrying no adulterants and containing no carrying agent. Third—it was chosen because of the fact that it was a live yeast in that when subjected to proper conditions of moisture and temperature the yeast started to grow and multiply just as normal live yeast will do. Lastly—the Fleischmann product was chosen because being in a dry state it was easy to store and handle.

Six hundred forty hens were used in the early 1924 test. They were all yearling hens which had laid heavily the previous year and which had been through an extended moult and had come back into normal production about the middle of January. They were all Single Comb White Leghorns. These hens were housed in eight similar breeding pens and during January eggs from these various pens had been incubated resulting in a normal fertility around 90% with a very satisfactory hatchability for that season of 66%. During early February the fertility from these pens took a decided slump which condition is generally characteristic at that particular season. It was at this time that the yeast feeding was thought of and the experiment started. The eight pens containing the 640 birds were then divided into two groups. Both groups had been receiving a moist mash which they would consume in about an hour, same being fed each day at about 11 o'clock. Group A consisting of pens 1, 3, 5 and 7 were, beginning February 15,—fed the same moist mash but ½% of Fleischmann's Pure Dry Feed Yeast was added and the mash allowed to stand and ferment in a warm room for about twenty hours before feeding.* The remaining pens, 13, 15, 17 and 19 were given no yeast but were handled just as they had normally been. The following table shows the number of eggs set each month through May, the percent of fertility and the percent of hatch of total eggs set.

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*Feeding Directions—Based on the weight of the dry mash used, ½ of 1% of dry yeast was mixed with the dry mash and sufficient water (preferably warm) added to moisten the mash. After thorough mixing the mash was set aside in a warm place and allowed to ferment at a temperature of about 70° F. for twenty to twenty-four hours and was then fed. The quantity should be such that it will be consumed in an hour's time. The mash should be wet so that it will still crumble and a little moisture appear between the fingers when a handful is tightly squeezed. Buttermilk may be used in place of water. If a somewhat higher temperature (about 80°) can be maintained, ¼ of 1% yeast may be used. The fermentation may be further accelerated by making the mash more moist. In this case it should be dried out by the addition of a little dry mash just before feeding. Fleischmann's Pure Dry Yeast may be fed in the dry mash which is before the birds all the time, but best results are obtained by feeding the fermented mash as used by Professor Lewis. Besides the beneficial action of the active yeast on the proteins and carbohydrates of the mash, the yeast content in such a medium is multiplied about ten-fold. When this moist mash is fed to the birds they are consuming the yeast in a live active state in which it can best serve its purpose.

TABLE NO. 1

DETAILED RESULTS OF FIRST OR MIDWINTER EXPERIMENT

Yeast Pens

Pens	1	3	5	7
No. Birds	85	81	74	80

	Eggs Set	320 Hens Fertility	% Hatch Total Eggs
January	3100	91%	66%
February	3600	81%	*51%
March	4500	95%	72%
April	5800	93%	76%
May	4700	94%	78%

* Yeast fed—beginning February 15.

Non-Yeast Pens

Pens	13	15	17	19
No. Birds	83	78	81	78

	Eggs Set	320 Hens Fertility	% Hatch Total Eggs
January	2900	90%	66%
February	3400	82%	53%
March	4500	78%	50%
April	5300	87%	69%
May	4500	92%	74%

From a study of table No. 1 it will be noticed that during January and throughout February the fertility and hatch ability from both groups of birds were about the same. In March, however, we see a decided gain for the yeast fed pens. The fertility jumping from 81% in February to 95% in March and the hatchability from 51% in February to 72% in March. While in the case of the non-yeast fed pens the fertility dropped from 82% in February to 78% in March and the hatch dropped from 53% to 50% in March. This condition in the non-yeast fed pens is typical of the regular late winter slump which is generally experienced in the hatching business. In April the yeast fed birds continued to show a very high fertility with an exceedingly satisfactory hatchability, and the same condition continued throughout May. In the case of the non-yeast fed pens an examination of the table will show a gradual increase in fertility and hatchability throughout April and May until the average hatch in May was nearly equal to the yeast-fed breeders. It is very apparent from a careful examination of these figures that yeast played a very important part in inducing high fertility and excellent hatchability during this season. It was apparent from the detailed records of hatch that it required about ten days to two weeks feeding of yeast before its influence was observed upon fertility.

Had the yeast feeding started along in January the probability is that the 10% drop in fertility experienced during February with the 15% drop in hatchability could have been eliminated. These results were so definite and apparent that at their conclusion the data was submitted to the Fleischmann Yeast Company for their inspection and observation, with the result that an additional and somewhat more elaborate test was run during November 1924. The object of the second test being first to run a check on the spring experiment and second to try to ascertain, if possible, the reasons why yeast functions in this very definite way.

THE FALL EXPERIMENT

It has been the practice at Lewis Farms for a number of years to bring off a rather substantial hatch of chicks in November and utilize extensive brooder equipment throughout the winter to brood these chicks and market them the first of February as squab broilers. During the fall test two lots of three hundred early hatched pullets were used. The birds were Single Comb White Leghorns. They were hatched February 9, 1924, the eggs being saved the last three days in October and the first five days in November. All of these six hundred birds had been under lights since September 15 and had been giving a very satisfactory egg yield. In fact, they laid so long and so heavily that at the time the eggs were saved the majority of the birds were heavily bleached in shank and beaks and were free from any excess amount of body fat. Yearling cock birds were mated to the pens.

Pen 101 received a yeast fermented moist mash which had been fermented with Fleischmann's Dry Feed Yeast added at the rate of ½ of 1%. Pen 102 received no yeast whatsoever. In addition to this moist mash each pen received a standard New Jersey Dry Mash and scratch feed fed in deep litter. On November 5, 750 eggs from the yeast fed pen were set in five sections of a Newtown Giant Incubator and 600 eggs laid during the same period by the non-yeast fed pen were set in four sections of the same incubator. Care was taken to alternate the trays in the incubator so as to eliminate as far as possible any temperature or incubator influence. The incubator ran throughout the hatch very uniformly. The following table No. 2 shows the distribution of the yeast and non-yeast trays with the resulting percent of fertile eggs, dead germs, and healthy chicks taken from each tray, also the weight of the chicks from each tray as well as designating toe punch used in marking the various chicks.

TABLE NO. 2

GENERAL RESULTS OF FALL HATCH

Tray	Eggs	Treatment	Infertile	Dead Germs	Dead in Shell	Chicks	Weight	Mark
3	150	Yeast	28	13	10	99	8 lbs. 4 oz.	Outside
4	150	No Yeast	48	10	54	38	3 lbs. 6 oz.	Inside
5	150	No Yeast	48	13	38	51	4 lbs. 6 oz.	Inside
6	150	Yeast	29	4	31	86	7 lbs. 2 oz.	Outside
7	150	Yeast	27	7	28	88	7½ lbs.	Outside
8	150	No Yeast	43	13	58	36	3 lbs.	Inside
9	150	Yeast	40	9	44	57	5 lbs.	Outside
10	150	Yeast	23	9	39	79	6 lbs. 8 oz.	Outside
11	150	No Yeast	54	9	36	51	4 lbs. 3 oz.	Inside

In order to analyze the data shown on the above table intelligently and arrive at a comparative summary of the efficiency of the hatch from the yeast and non-yeast fed pens the following table No. 3 shows first, the detailed results secured from the hatch of 750 eggs produced by the yeast fed breeders and also the general results secured from the hatch of 600 eggs in four trays from the non-yeast fed breeders.

TABLE NO. 3

SUMMARY OF FALL HATCH

Yeast Fed Pens

Eggs	Treatment	Infertile	Dead Germs	Dead in Shell	Chicks	Weight	Aver. Wt.	% Hatch
150	Yeast	28	13	10	99	8 lbs. 4 oz.	1-1/3 oz.	66%
150	Yeast	29	4	31	86	7 lbs. 2 oz.	1-1/3 oz.	57–1/3%
150	Yeast	27	7	28	88	7½ lbs.	1-4/11 oz.	58–2/3%
150	Yeast	40	9	44	57	5 lbs.	1–23/57 oz.	38%
150	Yeast	23	9	39	79	6 lbs. 8 oz.	1.32 oz.	52–2/3%
750	*Totals. . .*	147	42	152	409	34 lbs. 6 oz.	1.34 oz.	54.5%

Non-Yeast Fed Pens

Eggs	Treatment	Infertile	Dead Germs	Dead in Shell	Chicks	Weight	Aver. Wt.	% Hatch
150	No Yeast	48	10	54	38	3 lbs. 6 oz.	1–8/19 oz.	25–1/3%
150	No Yeast	48	13	38	51	4 lbs. 6 oz.	1–19/51 oz.	34%
150	No Yeast	43	13	58	36	3 lbs.	1–1/3 oz.	24%
150	No Yeast	54	9	36	51	4 lbs. 3 oz.	1–16/51 oz.	34%
600	*Totals. . .*	193	45	186	176	14 lbs. 15 oz.	1.36 oz.	29.3%

It will be observed that where yeast was fed only 147 eggs were candled out as infertile from the 750 eggs set. Where no yeast was fed 193 eggs were candled out of 600 eggs set. When observing the very poor fertility resulting from the non-yeast fed pens it must be remembered that these birds had been laying heavily since late July, occasionally reaching as high as 70% production.

Analyzing the two tables and comparing the totals, we find that the percent of hatch in live, healthy, chicks based on all eggs set was in the case of the yeast fed pens 54.5 while in the case of the non-yeast fed pens it was 29.3. On the basis of all eggs set this is an increase of 25.2% in the hatch of vigorous, healthy chicks from the yeast fed pens over the non-yeast fed pens.

These results are certainly very marked in the increased fertility and hatchability which yeast fed birds impart to their eggs. The reasons why yeast accomplishes this result have not been scientifically determined. It is a known fact however, that yeast is the richest in vitamine B of any known feeding substance. The rations fed to the yeast birds were extremely rich in active live growing yeast plants which means that there must have been added to the ration of the yeast fed birds greatly increased quantities of vitamine B.

During the progress of the fall experiment careful laboratory tests were made of the fermented mash and it was found that when mixed and fermented as outlined above the actual increase in yeast plants as well as the increased weight of yeast in the mixture was about ten times. Which means that where ½% of dry feed yeast was added, after 20 hours of fermentation, there was approximately 5% of this product present.

TABLE NO. 4

YEAST COUNT ON MASH FERMENTED AT 38° C.

Time	Cells per Field	Cells per Gram of Mash
Beginning	10	624,000
12th hour	37	2,304,000
16th hour	65	4,048,000
20th hour	105	6,560,000

During the progress of the experiment, in fact from the first of August, both lots of birds had been confined to their laying quarters and had received in the nature of green feed only very limited quantities of mangel beets. There had been no opportunity for either lot of birds to secure any considerable amount of vitamine B from tender leafy plant growth which they would have been able to do if they had been running out-of-doors. Conditions, so far as the birds were concerned, were similar to midwinter or early spring breeding conditions.

Throughout the progress of the fall experiment the birds in the yeast fed pens seemed to show a decided increase in appetite which was probably due to the increased palatability of the yeast fermented mash. This increased palatability could not but help having a marked influence in increasing the general efficiency of the rations fed. The slight amount of alcohol present in the yeast fermented mash, no doubt, had a marked stimulating effect upon the breeders, males and females alike, which in all probability is a contributing factor to the very marked results secured.

RESULTING CHICK MORTALITY

Following the fall experiment on Nov. 26 the 408 chicks from yeast fed breeders were divided about equally between six Newtown coal burning stoves and 148 of the chicks from non-yeast fed breeders were about equally divided between the same stoves. The capacity of these six stoves being brought up to about 250 chicks each by the addition of other chicks hatched at the same time. At the end of three weeks some very definite figures were secured on chick mortality. The following table No. 5 shows the total mortality resulting from these six brooder pens.

TABLE NO. 5

REPORT OF CHICK MORTALITY FOR FIRST THREE WEEKS OF BROODING

	Total Chicks at Start	
	No Yeast	Yeast
Pen 4	24	66
Pen 2	24	66
Pen 3	23	68
Pen 1	24	69
Pen 5	28	68
Pen 6	25	71
	148	408

	Mortality	
	No Yeast	Yeast
Pen 4	3	3
Pen 2	5	1
Pen 3	2	2
Pen 1	3	6
Pen 5	4	3
Pen 6	2	7
	19	22
Total Percent Mortality	12.8%	5.4%

From the six brooder pens above mentioned at three weeks of age it will be observed that at the end of the 21st day in the brooder nineteen chicks from the non-yeast fed breeders had died out of the 148 chicks originally placed in the brooders. It will also be observed that 22 yeast fed chicks had died up to that age out of the 408 chicks originally placed in the brooders. This means that 5.4% of the chicks resulting from yeast fed breeders had died at the age of three weeks, while 12.8% of the chicks from the non-yeast fed breeders had died in the same period.

The results of this particular experiment show, therefore, a mortality at three weeks of more than double the number of chicks from the non-yeast fed breeders over the yeast-fed breeders. In analyzing the results of this second experiment it must be appreciated that it was work done outside of the normal breeding season, the breeding hens used for this work were not in good breeding condition having been forced for heavy

egg production for four months previous to the hatch, they having been confined to laying pens instead of having outdoor range.

SUMMARY

From the experimental evidence which is at hand it is quite apparent that the feeding of Fleischmann's Pure Dry Feed Yeast in the fermented moist mash to breeding hens very materially increases the fertility of the hatching eggs produced.

On the same basis it is very evident that the feeding of Fleischmann's Pure Dry Feed Yeast in a fermented moist mash very materially increases the hatchability of eggs so produced.

It is further evident that chicks produced from yeast-fed breeders have more vitality and are more disease-resistant as measured by the very material increase in percent of livable chicks at the end of three weeks of brooding.

The advantage of feeding yeast in the form of a fermented moist mash is very evident, due primarily to the great increase which takes place in the actual volume of yeast during the process of fermentation.

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