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Small Scale Egg Production: The Challenge of Portuguese Autochthonous Chicken Breeds

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Abstract: Biodiversity concerns and the sustainability of agroecological systems, together with consumer demand for higher quality products from alternative and extensive farming methods, have reinforced interest in local breeds that are well adapted to low-input environments. The first reference to Portuguese poultry breeds appeared in the 1930s, with registration and breeding programs of native breeds only being implemented in the last ten years. Portuguese chicken breeds (Pedrês Portuguesa, Preta Lusitânica, Amarela, and Branca) are almost extinct and are currently bred on small-scale farms for egg and meat production. This study aimed to characterize the performance of laying hens, evaluating the influence of genotype, age, and season on egg production over four years in farm conditions. The results highlight the Pedrês Portuguesa as the most productive breed regarding egg production and reveal a tendency for an increase in egg production performance by the Branca in contrast with the lower productive capacity of the Preta Lusitânica. Older hens start laying earlier in consecutive laying periods, present a shorter peak, and an inferior number of total eggs/cycle. There is a need to establish breeding goals and to evaluate and revise breeding programs to increase productivity in autochthonous Portuguese chicken breeds.

Keywords: poultry; local resources; laying hens; productive performance; small-scale; selection program

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1. Introduction

Genetic selection performed by the commercial poultry industry has produced highly specialized lines/strains for egg and meat production that are selected for improved performance and that are bred in controlled conditions [1,2]. Biodiversity, a present global concern, is seriously threatened, and globally, local varieties and breeds of domesticated plants and animals are disappearing. This loss of diversity, including genetic diversity, poses a serious risk to global food security by undermining the resilience of many agricultural systems to threats such as pests, pathogens, and climate change [3,4].

The conservation of animal genetic resources represents an opportunity for the promotion of local genetic resources with benefits for marginal areas that have economic, cultural, social, and environmental potential and scientific use and that contribute to the sustainable conservation of biodiversity [5–7].

At the same time, producers are discovering the potential of local breeds due to the rusticity, resistance and adaptability of native birds to different environmental conditions [1,7–10]. Moreover, the valorization of local traditions and products has renewed consumer interest in niche products [11,12].

Consumer concern regarding the sustainability of production and animal welfare has strongly increased the demand for eggs and meat that are produced through alternative and extensive farming methods. The demand has progressively focused on product quality traits, their intrinsic characteristics, and general awareness about poultry production methods [8,11–15].

The preservation of native breeds is highly relevant in diverse agro-ecological systems, particularly in low-input systems [16]. Out of 7.092 local breeds, 2.021 are considered to be at risk of extinction; for 4.351 of these breeds, their risk status remains unknown due to missing or outdated data [17]. In Europe and the Caucasus, 51% of local and regional farmed and domesticated animal breeds are at risk of extinction [17].

Among avian species, chickens have the greatest number of breeds at risk on a global scale by far [18]. The proportion of avian breeds of unknown risk status is even greater than that for mammalian species, and chickens comprise a considerable component of currently extinct species. It is estimated that 103 breeds of the 1.592 existing chicken breeds identified worldwide have become extinct, with 95 of them in Europe and the Caucasus alone; this region has by far the largest number of at-risk breeds [19].

The Global Plan of Action for Animal Genetic Resources aims to combat the erosion of animal genetic diversity and to use animal genetic resources sustainably [3,18–20]. In 2013, Portugal adopted a national plan to safeguard genetic diversity, which includes implementing and developing breeding programs to protect local breeds and creating a reservoir of variability that deserves to be explored and properly managed [21,22].

As animal genetic resources, local breeds offer an important opportunity due to their adaptation to constrained and impoverished feeding environments, endemic and exotic diseases, and changes in climate [4,23–27]. By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals as well as of their wild relatives, including other socio-economically and culturally valuable species, had been maintained; moreover, strategies were developed and implemented to minimize genetic erosion and to safeguard genetic diversity [28,29].

The domestic chicken has long been an important protagonist in traditional food, religious practices, entertainment, and ornamental design [30]. In Portugal, four autochthonous chicken breeds have been recognized as being at risk of extinction [21]. Since 2003, conservation programs for local chicken breeds have been developed in cooperation with the breeders' association (AMIBA), a genealogic register was created, and breed standards were approved. Recent studies of Portuguese chicken breeds have mainly focused on phenotypic and productive characteristics, defining patterns and productive systems [22,31,32].

Today, the four autochthonous chicken breeds are bred under traditional production systems in small family farms and serve as dual-purpose animals for meat and for eggs [33–35]. Females are generally used to produce eggs, while males are kept for meat production and are commonly sold as a whole carcass [36].

Little information can be found in the literature regarding the productivity [37] and quality traits of eggs laid by Portuguese autochthonous hens [35]. Eggs from Portuguese autochthonous hens match or supersede the quality of commercial products in many characteristics [35] and present valuable quality traits, such as a higher yolk—-albumen ratio, higher eggshell breaking strength, and an optimal fatty acid (FA) profile, showing a better nutritional balance among long-chain FAs [13,35,38–40].

Overall physical and chemical analyses have indicated that eggs from native breeds, especially those from the Pedrês Portuguesa and the Preta Lusitânica, present higher quality traits [34]; in alternative farming systems, double-purpose genotypes may exhibit satisfactory productive performance [37].

Poultry products obtained from native pure breeds offer unique features and valuable quality traits, underlining the necessity of local resource selection programs [41,42]. In a small-sized poultry population, as is the case with the Portuguese chicken breeds, a delicate balance needs to be determined between biodiversity preservation and performance improvement in order to avoid inbreeding and to maintain the breeds' adaptation to the low-input environment [43].

The aim of this study is to characterize the yield performance of indigenous Portuguese hens, evaluating the productive variability in these populations and the different factors that may contribute to this variability. Knowledge of the productive traits will support the implementation of technical and scientific strategy aiming to exploit their productive potential and to ensure the support of local breeds in low-input systems.

2. Materials and Methods

The study was conducted in accordance with EU Directive 2010/63/EU; it complied with the Portuguese legislation on animal care (DL n. 113, 7 August 2013) and adhered to the internal rules of the Polytechnic Institute of Viana do Castelo.

2.1. Sample Size and Distribution

The material comprised hens from the four Portuguese autochthonous breeds: "Amarela", "Branca", "Pedrês Portuguesa", and "Preta Lusitânica" (Figure 1). A characterization of each breed according to the Genealogical Register is listed in Table 1.

(1) (2) (3) (4)

Figure 1. The four Portuguese autocthonous chicken breeds: (**1**) Amarela; (**2**) Branca; (**3**) Pedrês Portuguesa; (**4**) Preta Lusitânica.

Table 1. Characterization of Portuguese autochthonous breeds.

<table>
<tr><th></th><th>Trait</th><th>Age (Days)</th><th>Amarela</th><th>Branca</th><th>Pedrês Portuguesa</th><th>Preta Lusitânica</th><th>References</th></tr>
<tr><td rowspan="5">Males</td><td>Body weight (g)</td><td>180–360
361–720
>720</td><td>2679
3218
3379</td><td>2932
3265
4460</td><td>2530
3235
3500</td><td>2336
2684
2887</td><td>[32]</td></tr>
<tr><td>Body length (cm)</td><td>180–360
361–720
>720</td><td>45.8
46.6
47.4</td><td>46.5
47.8
47.9</td><td>46
46.5
46.2</td><td>44.3
45.7
46.2</td><td>[32]</td></tr>
<tr><td rowspan="2">Chest circumference (cm)</td><td>180–360</td><td>36.4</td><td>37.6</td><td>37.2</td><td>33.4</td><td rowspan="2">[32]</td></tr>
<tr><td>361–720
>720</td><td>39.6
37.8</td><td>38.2
40.8</td><td>36.9
40.3</td><td>34.8
36.4</td></tr>
<tr><td>Carcass weight (g)</td><td>270–365</td><td>2020</td><td>2483</td><td>2043</td><td>2016</td><td>AMIBA—unpublished data</td></tr>
<tr><td rowspan="4">Hens</td><td>Body weight (g)</td><td>180–360
361–720
>720</td><td>1781
2078
2166</td><td>2004
2056
2284</td><td>1898
2100
2253</td><td>1902
2098
2231</td><td>[32]</td></tr>
<tr><td>Body length (cm)</td><td>180–360
361–720
>720</td><td>39.2
39.4
39.4</td><td>41
40.5
40.8</td><td>40.9
40.9
41.5</td><td>40.2
40.7
40.7</td><td>[32]</td></tr>
<tr><td>Chest circumference (cm)</td><td>180–360
361–720
>720</td><td>32.6
33.4
33.8</td><td>32.9
33.9
35</td><td>32.8
33
34.9</td><td>31.8
32.4
32.2</td><td>[32]</td></tr>
<tr><td>First season laying performance</td><td>(eggs/year)</td><td>98</td><td>135</td><td>129</td><td>71</td><td>AMIBA—unpublished data</td></tr>
<tr><td rowspan="4"></td><td colspan="2">Conservation program implemented since year</td><td>2004</td><td>2014</td><td>2003</td><td>2003</td><td>[27,36]</td></tr>
<tr><td colspan="2">Number of breeders</td><td>166</td><td>136</td><td>272</td><td>202</td><td rowspan="3">AMIBA—Genealogical Register (30 June 2021)</td></tr>
<tr><td colspan="2">Number of males</td><td>959</td><td>562</td><td>1068</td><td>1049</td></tr>
<tr><td colspan="2">Number of hens</td><td>6393</td><td>3503</td><td>6439</td><td>6330</td></tr>
</table>

All of the records were taken from hens bred in 33 farms (Table 2) in the continental region of Portugal and in the Azores Islands and were distributed as follows: Amarela, 20 flocks; Branca, 13 flocks; Preta Lusitânica, 17 flocks; and Pedrês Portuguesa, 24 flocks. These farms were characterized by a small number of hens (less than 25), with several flocks sorted by breed and each flock having 1 male for every 10 hens on average. Production had been undertaken for double purposes: egg production (hens), and breeding, fattening, and slaughtering (roosters), with the desired 3.0 kg body weight being achieved within 9 to 12 months [36]. The number and replacement rate of the hens were dependent on the farmer's management decisions without any experimental design influences.

Table 2. Hen number, by breed and year, during four laying seasons.

			Number of Individuals (Hens)				
Farms	**Breed**	**Flocks**	**2017**	**2018**	**2019**	**2020**	**2017–2020 ***
33	AM	20	339	375	478	527	845
	BR	13	132	101	128	188	501
	PP	24	352	362	456	525	889
	PL	17	253	235	308	475	796
Total		74	1076	1073	1370	1715	3031

AM—Amarela; BR—Branca: PP—Pedrês Portuguesa; PL—Preta Lusitânica. * Most hens were observed for over more than one laying season.

2.2. Study Site Characterization and Sample Animals Management

The study was conducted under field conditions from January 2017 to December 2020 and was based on the flocks being bred by farmers over that tine (Table 3). The animals comprising the sample were raised and kept by backyard producers under extensive conditions and were fed on corn and farm fodder, which were complemented with surplus or by-products from human or animal feeding. The hens were not vaccinated against viruses or parasites nor were they treated; antibiotics and multivitamins were not administered.

Table 3. Number of flocks per breed (N) and average number of hens (Mean) per breed and flock over the four laying years.

Year	Breed	N	Mean	SD	Max	Min	Year	Breed	N	Mean	SD	Max	Min
2017	AM	20	13.5	6.6	20	3	2018	AM	20	12.9	5.9	20	5
	BR	13	13.1	5.4	20	7		BR	13	9.8	5.7	20	2
	PP	24	14.5	5.1	20	4		PP	24	15.1	5.1	20	2
	PL	17	15.3	5.2	20	5		PL	17	13.1	5.3	20	5
	TOTAL	74	14.1	5.6	20	3		TOTAL	74	12.7	5.6	20	2
2019	AM	20	14.5	5.2	20	6	2020	AM	20	15.1	5.9	20	2
	BR	13	11.6	5.9	20	2		BR	13	12.1	6.5	20	3
	PP	24	15.7	4.9	20	6		PP	24	15.3	5.2	20	5
	PL	17	16.3	5.1	20	5		PL	17	15.4	6.1	20	1
	TOTAL	74	14.5	5.3	20	2		TOTAL	74	14.5	5.9	20	1

N—number; SD—standard deviation; Max—maximum; Min—minimum; AM—Amarela; BR—Branca: PP—Pedrês Portuguesa; PL—Preta Lusitânica.

The production cycle was controlled during the 4 years (Table 4). Egg production was recorded daily and throughout the laying period, from each flock, hen—day egg production (number of eggs/number of live hens' × 100) was established.

Table 4. Hen number (N) and average laying age (Mean) in days over the four laying year periods.

Year	Breed	N	Mean	SD	Max	Min	Year	Breed	N	Mean	SD	Max	Min
2017	AM	339	743.4	488.1	2585	172	2018	AM	375	756.8	523.0	2950	177
	BR	132	717.4	319.1	1856	232		BR	101	831.4	452.0	2221	177
	PP	352	845.8	613.6	2418	181		PP	362	760.9	614.7	2587	167
	PL	253	591.3	440.8	2354	152		PL	235	603.0	310.5	1587	153
	TOTAL	1076	737.9	514.6	2585	152		TOTAL	1073	731.5	517.5	2950	153
2019	AM	478	707.4	385.0	2191	173	2020	AM	527	753.5	439.2	2557	191
	BR	128	875.4	486.4	1868	185		BR	188	834.6	512.5	1918	199
	PP	456	803.2	608.8	2858	173		PP	525	845.0	448.5	2328	234
	PL	308	611.6	351.9	1769	161		PL	475	781.1	401.2	1623	174
	TOTAL	1370	733.4	481.3	2858	161		TOTAL	1715	793.5	445.5	2557	174

N—number; SD—standard deviation; Max—maximum; Min—minimum; AM—Amarela; BR—Branca: PP—Pedrês Portuguesa; PL—Preta Lusitânica.

2.3. Data Analysis

Descriptive statistics (mean, standard deviation (SD), minimum/maximum values) were generated for all of the variables in the dataset.

A two-way ANOVA test was used to determine the effects of breed, month, and year, and differences between means were determined by Tukey's test using the general linear model analysis of IBM SPSS Statistics 23.0 [44]. Linearity was tested, and different models were analyzed (linear, quadratic, exponential, Bayesian) to estimate productivity. The one that fit best when using the curve estimation model analysis was the cubic polynomial regression (x^3). Homoscedasticity and normality were also tested using a scatterplot and recurring Shapiro–Wilk test, respectively [44]. All statements of significance were based on testing at the *p*. 0.05 level.

A non-parametric correlation matrix, the Spearman's coefficient method, was selected due to the presence of categorical and numeric variables; productivity, climate (monthly temperature, collected from IPMA—Portuguese Institute of the Sea and Atmosphere) [45], and time (season/month) parameters correlations were obtained.

3. Results

3.1. Flock Characterization: Number and Age of Hens

This study replicates the proportion of both breeders and animals: Pedrês Portuguesa has the highest number of breeders and animals followed by Amarela, Preta Lusitânica, and Branca. The lower number of hens and breeders in relation to Branca is due to the recent implementation of the breeding program and the Genealogic Register. Preta Lusitânica, the second-least-bred hen variety, shows a higher average number of hens per flock in three of the four years under analysis, which can be explained by the lower hen replacement rate and renewal opportunity, as observed in the last laying period.

When analyzing the hens average laying age evolution (Table 4), no significant differences were observed ($p = 0.529$) between years. However, during this period, the Preta Lusitânica hens presented a lower average laying age (646.8 days), which was particularly relevant ($p = 0.01$) in relation to the Pedrês Portuguesa (813.7 days) and the Branca (814.7 days) breeds.

3.2. Breed Effect

Concerning the effect of breed on laying performance (Figure 2), values ranged between 8.08% (percentage laying hens/day) in December for Preta Lusitânica and 56.22% in April for Pedrês Portuguesa. Pedrês Portuguesa appears to be the most efficient ($p \leq 0.001$) laying breed (120 ± 28.5 eggs/year), while Preta Lusitânica is the smallest ($p \leq 0.001$) producer (67 ± 24.5 eggs/year). The Amarela (85 ± 24.4 eggs/year) and Branca (82 ± 25.6 eggs/year) breeds performed similarly ($p = 0.163$), with Branca standing out in certain months through a higher laying rate and with Amarela showing greater annual uniformity.

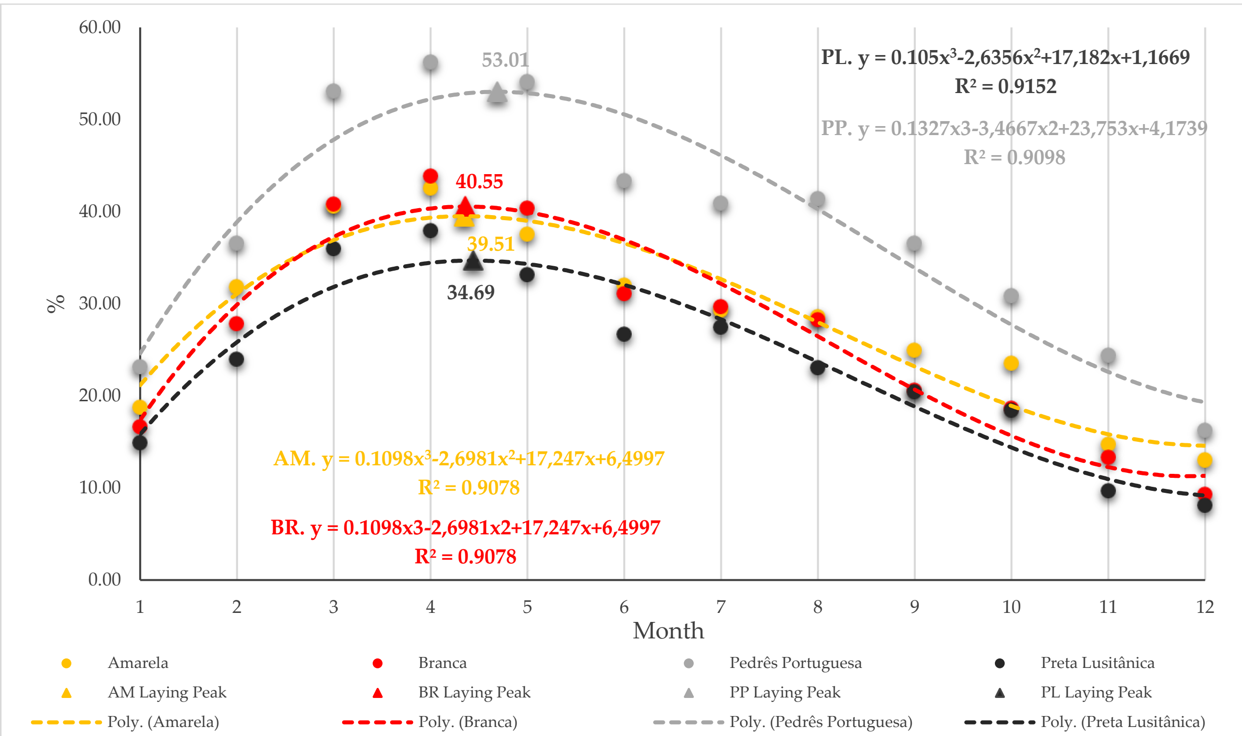

Figure 2. Productivity estimation (y) between 2017 and 2020 adjusted by month (x) for the four Portuguese autochthonous hen breeds (% laying hens/day).

3.3. Year and Month Effects

When considering the year effect (Figure 3), significant differences ($p \leq 0.001$) in the laying performance between years were observed. Hens increased egg production, with the exception of in the last two years for Pedrês Portuguesa, the most productive breed. Relative productive aptitude was maintained between genotypes even though an increasing performance proximity between the Branca and Amarela hens was observed, which was a result of the Branca's laying selection. Laying activity differed ($p \leq 0.001$) between months in all breeds, with a laying peak between March and June being more noticeable in higher productivity breeds (53.1% Pedrês Portuguesa and 40.5% Branca) (Figure 3).

In the analysis of monthly laying persistence, significant ($p \leq 0.001$) egg production reductions (Figure 4) were observed in June (from Branca—21.2% to Amarela—13.1%) and between November and January (from Preta Lusitânica—27.3% to Branca—21.3%). Positive ($p \leq 0.001$) laying activity was seen from January to April, with a different laying pattern being higher in February for the Amarela hens (30.7%) and higher in March for the other breeds (from Pedrês Portuguesa 29.4% to Preta Lusitânica 31.7%).

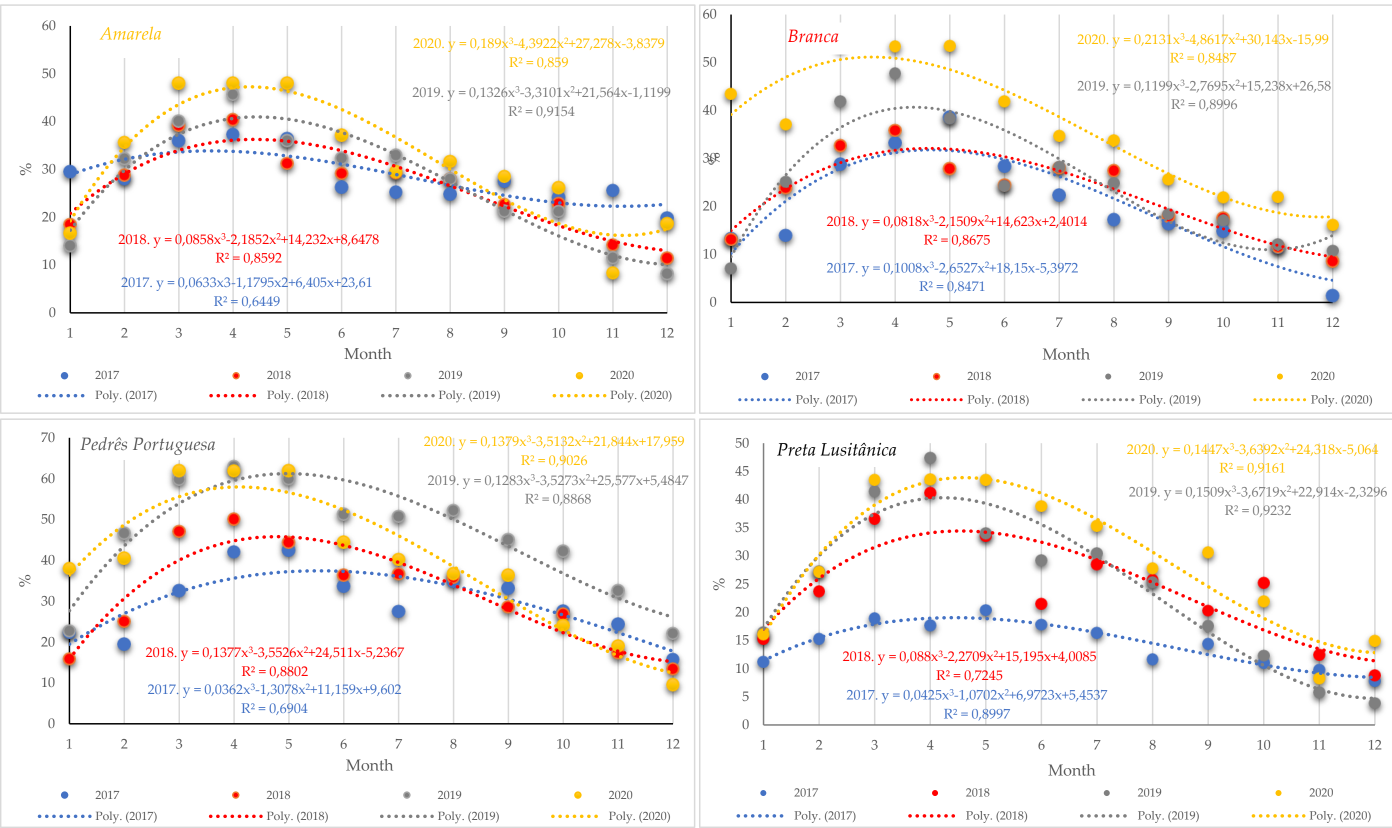

Figure 3. Productivity estimation (y) per year (x) and breed between 2017 and 2020 for the four Portuguese autochthonous hen breeds (% laying hens/day).

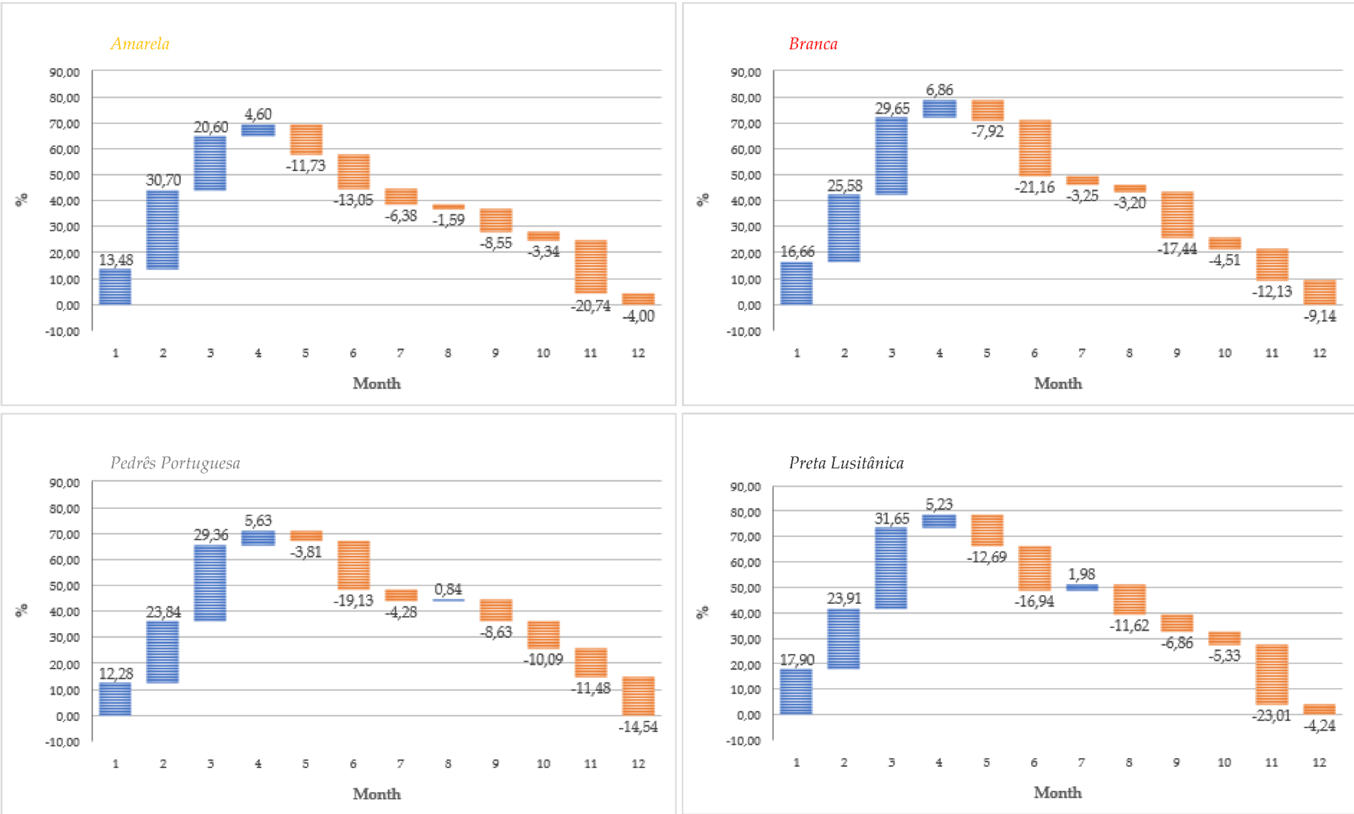

Figure 4. Laying persistence per month and breed between 2017 and 2020 for the four Portuguese autochthonous hen breeds.

3.4. Correlations

The Spearman correlations between the production rate, climate, and time parameters are given in Table 5 for all of the birds. All of the correlations between the production rate, month, and season were negative and significant ($p \leq 0.01$), ranging from -0.273 (month) to -0.152 (season). High significant ($p \leq 0.01$) positive correlations were recorded between season and month (0.841), climate parameters (°C Min., °C Avg. and °C Max.), and between °C Min. and season (0.542).

Table 5. Spearman correlations between production rate, climate, and time data for all breeds.

	Month	Production Rate	°C Min.	°C Avg.	°C Max.	Season
Month	1					
Production rate	−0.273 **	1				
°C Min.	0.485 **	0.048 **	1			
°C Avg.	0.403 **	0.077 **	0.977 **	1		
°C Max.	0.326 **	0.090 **	0.952 **	0.993 **	1	
Season	0.841 **	−0.152 **	0.523 **	0.488 **	0.458 **	1

Min—Minimum; Avg—Average; Max—Maximum; ** Correlation is significant at the 0.01 level (2-tailed).

4. Discussion

Genetic and productive characterization of the Portuguese autochthonous breeds is relatively recent [31,32,34–37], and there is still minimal information about small-scale production, demographic evolution, small producers' social impact and commercial circuit organization.

The preservation of autochthonous chicken breeds was obtained through backyard production with small flocks and for self-consumption (eggs or meat) purposes. According to AMIBA registers (no published data), a significant majority of producers (98%) have less than 20 animals/flock, especially those with flocks of Pedrês Portuguesa, the most productive laying breed, with 14.9 hens/breeder. In our study, the same production system was observed with similar flock sizes and a lower average number of hens in the Branca breed and with a more recent breeding program. The number of hens and flock productivity is critical for niche product market development and in commercially oriented systems [46,47].

The main challenge in the traditional production system for Portuguese native hens presupposes product differentiation in the dual-purpose breeds, their potential improvement, an agroecologically based breed characterization, and commercial organization with a market-oriented vision. Functionally, from a productive point of view, in unselected populations, large animals tend to be destined for meat production and small animals for egg production [41,48]; however, in our results, the Preta Lusitânica genotype, the smallest (shorter, lighter) hen [32], was shown to be the least productive. Considered genetically closer to the ancestor of avian populations [31], its use in cultural and religious practices, and the absence of a selection program could explain its low laying breed capacity.

The Pedrês Portuguesa is the most well-known native Portuguese chicken breed, with a larger total population size and a widespread dispersion [49]. The breed's higher egg production capacity is linked to a long and traditional preference by producers for egg-laying breeds that can readily meet self-consumption needs and that can provide potential extra income through the selling of sought-after eggs [11,42,46].

The demand for local products deriving from sustainable production systems has risen exponentially, enabling the introduction of products stemming from native breeds, such as the Portuguese hens, in commercial chains [50]. However, a bottleneck exists between production and demand due to the small size of flocks, the rearing system, and the lack of product as well as commercial organization without a market-oriented vision [11,13,42].

Under outdoor rearing conditions, particularly in terms of inherent resistance and adaptation to different environmental conditions, egg production changes according to physiological and behavioral responses [38,40–42]. Productivity is significantly influenced by the age of the hens and the season, predominantly temperature and humidity, in tandem with the rearing system [10,51].

In all the four breeds, a tendency for production increase was observed across all years. Branca hens with a recent breeding program, namely an open production cycle with animals coming from external hatcheries or pullet farms and a high replacement rate per year, show an interesting laying potential capacity.

The laying performance of Pedrês Portuguesa increased during the four-year period, but not as expressively in the final two years. Genotype, rearing system, and age could explain this productive behavior. Being bred in a closed productive cycle, in which farmers keep breeder birds to produce a number of chicks every year, thus maintaining a particular sentimental attachment towards their flocks, resulted in a lower replacement rate. Older hens present an earlier new laying cycle, an inferior number of total eggs/cycle after the third productive cycle, and a shorter and advanced peak, resulting in a lower production capacity [37,52].

To improve quantitative traits, such as productive performance or egg quality, the breeders' association has provided selected chicks that have been incubated in its hatchery. However, due to insufficient supply, the large majority of the breeders use the closed productive cycle, in which the next generation of birds is selected from the offspring of the breeders reared on site. Similar production and rearing systems have been reported concerning small-scale poultry farming and backyard poultry [11,53,54].

The environmental factors conditioned the beginning of the productive period and the laying cycle length, influencing the hens' physiological responses and egg production in terms of egg mass and quality [10]. Generally, higher performances are observed in summer and autumn in a cage rearing system and in the spring in organic rearing systems [50,51,55,56]. For all of the Portuguese chicken breeds, higher productivity was observed in the spring, highlighting a dependence on the rearing system and environmental factors (such as temperature) [11,14,35].

Productivity persistence in the monthly breed analysis is similar, with a January-April increase until the laying peak in April and significant reductions in June and November–December. The Amarela breed presents an earlier increase trend, which is more evident in February's rate.

The reduction in the persistence values in June are a consequence of natural hatching, which is traditional for this type of rearing system; in November–December, however, this reduction is due to environmental factors (temperature and photoperiod) [11,14]. Temperature showed a significant but low correlation with productivity and was also highly influenced by different effects, such as diverse environmental factors, genotype, hatching type, and production or accommodation systems.

Agrobiodiversity conservation strategies are crucial for the association between endogenous resources, such as breed and non-market values [57]. A substantial concern by consumers in biodiversity preservation and welfare induces [58], in consumers and citizens, a WTP (willingness-to-pay) for the conservation program, which is driven by perceptions of taxpayer responsibility in conservation as well as products associated with said perceived purchaser responsibility [59].

Most breeders both consumed and sold the eggs that were produced; due to overproduction in relation to private citizens and national regulations, small-scale producers have supplementary difficulties selling eggs to shops and restaurants. A holistic strategy that includes the incentive of egg production and quality, the promotion of new market-oriented farms or an increase in the organization of small-scale production is necessary in the valorization of the Portuguese autochthonous chicken breeds.

The four native Portuguese breeds perform well under extensive systems [31,32,34–37], which are respectful to animal welfare and the environment and conserve adaptation to low-input rearing systems, which may positively affect the quality of the products [42,43]. Considering dual-purpose breeds, genetic and productive characterization must be intensified to define technical and scientific strategies to exploit their productive potential and to differentiate production aptitude, either for eggs or for meat. This study supports other findings [31,32,34–37] that indicate a tendency to select quantitative traits related to egg production in the Pedrês Portuguesa and Branca breeds.

5. Conclusions

The characterization of the four native Portuguese chicken breeds and products, which attend to the current increase in the market demand for alternative products with non-conventional quality, could be a strong contribution to future forms of sustainable poultry production.

Reared in small flocks and under outdoor conditions, the productive performance of the hens changed according to genotype, season, and age. Productivity is highly influenced by the rearing system and environmental factors, highlighting its relevance to a market-oriented production and the efficient commercial chain organization of small-scale farms.

The results also revealed the presence of wide variation among Portuguese hen breeds. Small-scale poultry productions are largely influenced by breeders' decisions that, in many cases, are made for sentimental or cultural reasons rather than by being influenced by economic or productive details.

The absence of technical criteria in the selection process is more evident in the Preta Lusitânica, the smaller, lighter, and less productive breed. The Pedrês Portuguesa and the Branca hens presented an encouraging laying capacity tendency in order to implement an oriented selection program.

Local breeds offer opportunities to adapt livestock to low-input environment, so their preservation is highly relevant when developing agro-ecological systems. Further research on the characterization of the quality of differentiated products should be developed to support and to valorize small-scale poultry productions.

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