ZINC-PROTOPORPHYRIN CONTENT IN COMMECIAL PARMA HAMS AND ITS RELATIONSHIP WITH COMPOSITION PARAMETERS

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Abstract – Zinc-protoporphyrin (ZnPP) and heme content were determined in twenty-three Parma hams made without the addition of curing agents. A Principal Component Analysis was carried out to examine the existing correlations between these pigments and various physicochemical parameters in the final product. Results showed the existence of associations between ZnPP, color scores, type of producer and salt content. Moreover, the conversion of ZnPP from heme seems to be facilitated in those hams with a higher proteolysis index which suggests the existence of complex interactions.

Key Words – dry-cured ham, pigments, proteolysis.

I. INTRODUCTION

The main pigments responsible for the color of non-nitrified dry-cured hams are heme and zinc-protoporphyrin IX (ZnPP) [1-3]. To obtain ZnPP, the heme moiety coordinates with Zn instead of Fe provoking the distinctive bright and stable color of Parma hams [1]. Limited data are available on ZnPP content in Parma hams and its formation pathway in meat products is not completely elucidated. In hams, the formation of ZnPP seems to be mainly determined by the action of the endogenous enzyme ferrochelatase which is affected by several factors including NaCl content, temperature and pH [4, 5]. However, other complex mechanisms may also occur simultaneously [6, 7]. In this connection, a limited proteolysis of the globin has been reported to facilitate the activity of the enzyme [8]. Therefore, this work is aimed at reporting typical ZnPP contents in commercial Parma hams and, on the other hand, to gain a better knowledge about the existing relationships between this pigment and various physicochemical characteristics of the final product.

II. MATERIALS AND METHODS

Twenty-three packages of PDO Parma sliced dry-cured ham with an elaboration time between 12 and 20 months were obtained from 6 producers. Subcutaneous fat was discarded for analysis. Protein content and proteolysis index were determined as described elsewhere [9]. Fat and chloride content were determined according to the ISO 1443:1973 and ISO 1841-2 methods [10]. Moisture was determined by drying the samples at 103°C. Water activity was measured with a Novasina instrument. The assessment of overall redness was carried out by 3 trained panelists. Heme content was determined as described by the Hornsey's method [11]. The determination of ZnPP content was achieved by measuring the fluorescence of ZnPP in ethyl acetate/acetic acid (4:1, v/v) sample extracts as described elsewhere [3].

III. RESULTS AND DISCUSSION

The ZnPP content in Parma ham slices averaged 45 mg/kg dry matter, ranging from 23 to 85 mg/kg. This is in close agreement with the reported contents in *Biceps femoris* and *Semimembranosus* muscles ranging from 40 to 54 mg/kg dry matter [7]. The heme content averaged 37 mg/kg dry matter, ranging from 17 to 73 mg/kg. Overall, ZnPP is about 1.4 times the heme content but showing a broad variability between samples. Wakamatsu *et al.* [3] reported that ZnPP accounted for two-thirds of all porphyrins whereas Parolari *et al.* [7] reported ratios slightly higher than 1. In Figure 1 it can be observed that heme and ZnPP are plotted in the first component direction as for salt content, moisture and color scores. The observed strong association between the producer and salt content may be explained by the different companies' production processes. In the second component, ZnPP, redness scores and the producer are plotted in similar co-ordinates and opposed to heme, pH and water activity. Therefore, the second component seems to mainly explain the conversion of heme into ZnPP. Results supported the idea that the conversion of heme into ZnPP is favored with elevated salt contents which is in agreement with the reported enzyme activity in *in vitro* studies [4]. Extended ripening periods also increased ZnPP [7]. The ZnPP/heme ratio is correlated with proteolysis which is in

good agreement with recent findings in *in vitro* studies [8]. These results suggest that various factors governed the formation of this pigment.

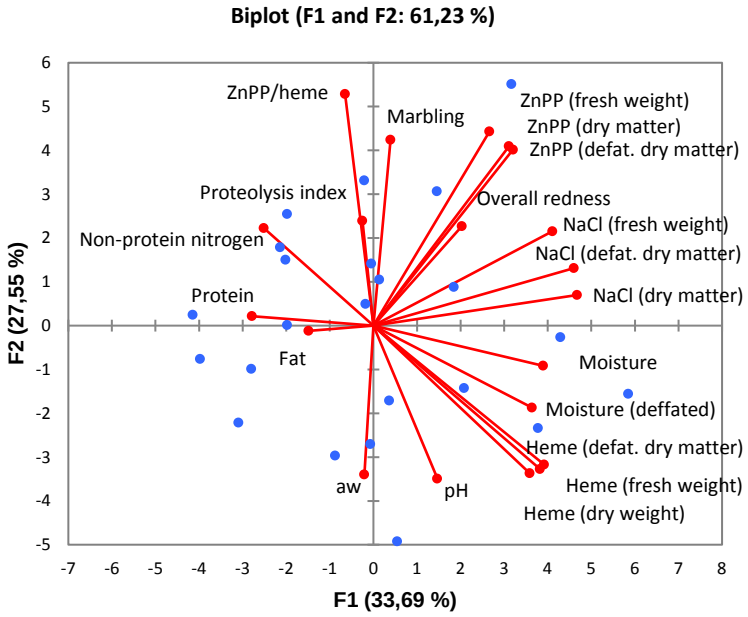

Figure 1. Principal component analysis. The abbreviation ZnPP stand for zinc-protoporphyrin.

IV. CONCLUSION

Results in commercial Parma hams are in line with previous findings in hams and meat models. In this regard, proteolysis may be an important factor in determining ZnPP content and reinforces the idea of the existence of complex mechanisms.

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