XANTHAN PRODUCTION ON WINERY WASTEWATERS: OPTIMIZATION OF PROCESS PARAMETERS IMPORTANT FOR BIOPOLYMER QUALITY

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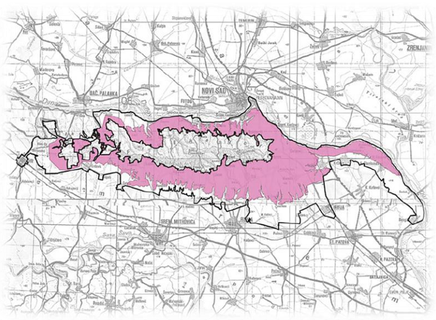
Intensive growth of wine industry during the last few decades is responsible for various ecological problems due to disposal of huge volumes of untreated wastewaters. Winery wastewaters are difficult to treat by conventional methods because of its seasonal nature, unequal composition and substantial flow variations. Over the past years, biotechnological processes for obtaining market-valuable products have received a considerable attention for reuse of various industrial effluents and utilization of inorganic and organic pollutants. In previous research, the biotechnological production of xanthan, commercially the most important microbial biopolymer widely used in different branches of industry, is proven as sustainable solution for winery wastewaters utilization. Considering that xanthan application directly depends on its quality, it is important to ensure that cultivation of selected xanthan-producing microorganism on winery wastewaters always results in accumulation of high-quality biopolymer. Temperature, aeration intensity and agitation speed are among the most important bioprocess parameters that affects the xanthan quality, and therefore its possible application.

The objective of this study was to optimize the values of bioprocess parameters important for quality of xanthan produced on winery wastewaters, i.e. temperature, aeration intensity and agitation speed.

The reference strain *Xanthomonas campestris* ATCC 13951 was used as xanthan-producing microorganism. Medium for xanthan biosynthesis was prepared by mixing the wastewaters generated in different stages of white wine production (crusher washing, press washing and flotation tank washing) to achieve initial sugar content of 30 g/L.



Xanthan production process was carried out in 7 L laboratory stirred tank bioreactor under aerobic conditions for 96 h at different values of temperature (25-35°C), aeration intensity (1.0-2.5 vvm) and agitation speed (200-800 rpm) that were varied according to Box-Behnken design (3^3).

The average molecular weight of xanthan (M_w) and apparent viscosity of its 1% (w/v) aqueous solution (η_a) were determined as indicators of produced biopolymer quality.

The response surface methodology (RSM) was used to define quadratic mathematical equations, which describe individual and interactive effects of examined parameters on xanthan quality, while desirability function was applied to optimize their values.

Table 1. Optimal values of examined factors and selected responses

Factors and responses	Goals	Optimal values
Temperature (°C)	In range	28.43
Aeration intensity (vvm)	In range	1.91
Agitation speed (rpm)	In range	410.53
M_w (10^5 g/moL)	Maximize	7.65
η_a (mPa·s)	Maximize	60.96
Desirability	0.964	

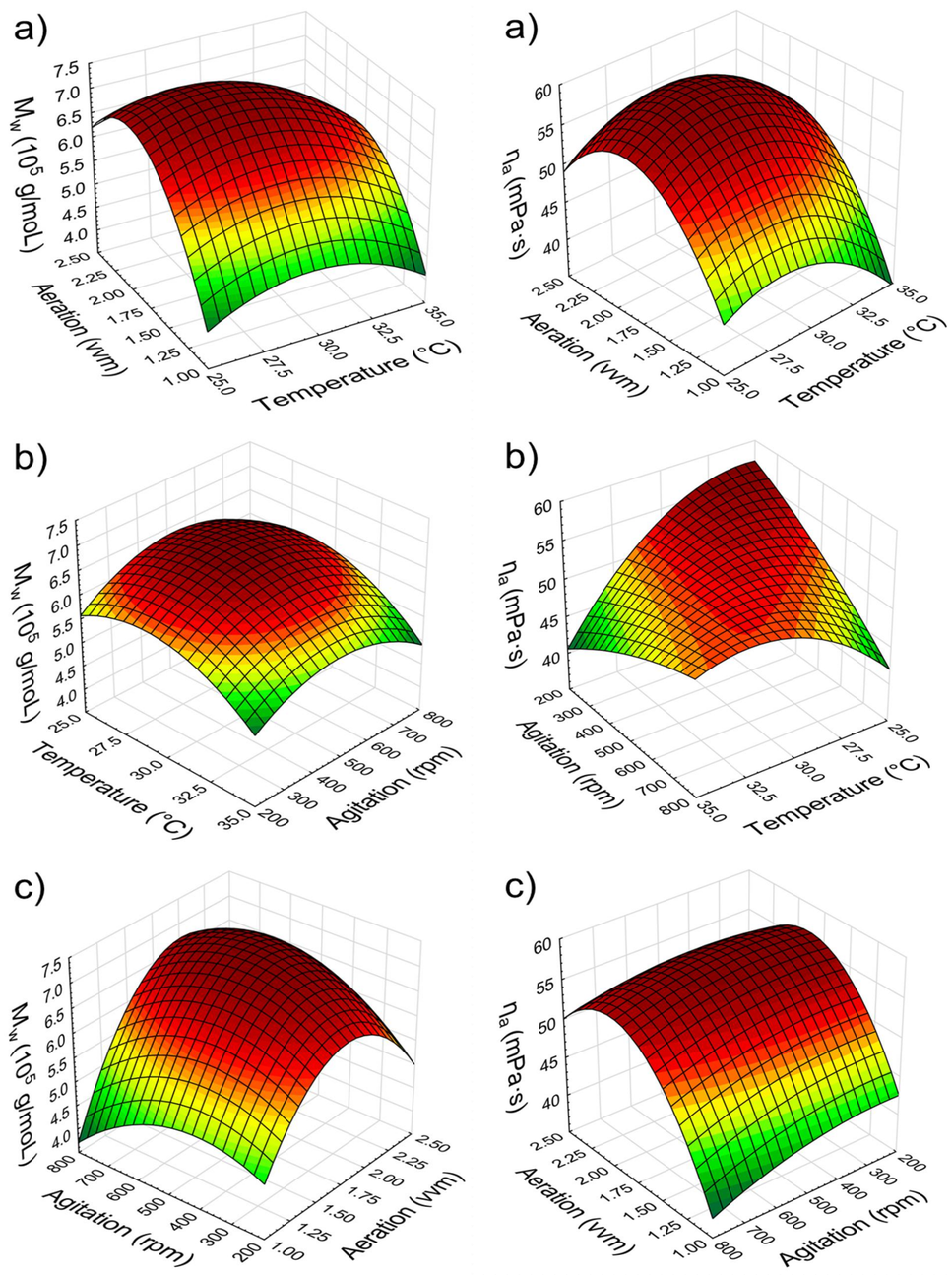


Figure 1. Average molecular weight of xanthan (M_w) as function of two factors at constant third:
a) Agitation (500 rpm)
b) Aeration (1.75 vvm)
c) Temperature (30°C)

Figure 2. Apparent viscosity of xanthan solution (η_a) as function of two factors at constant third:
a) Agitation (500 rpm)
b) Aeration (1.75 vvm)
c) Temperature (30°C)

The results obtained in this study represent valuable information about quality of xanthan produced under different bioprocess conditions that can be used in further investigation related to development of biotechnological production of xanthan on winery wastewaters.

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